1979

# Twenty-second Annual Cattle Feeders Day

Animal Science Department
*South Dakota State University*

22ND ANNUAL

SDSU

# CATTLE FEEDERS DAY

JANUARY 12, 1979
SOUTH DAKOTA STATE UNIVERSITY
BROOKINGS, SD

## "BULLISH ON BEEF"

CATTLE FEEDERS DAY
Friday, January 12, 1979
Animal Science Arena, SDSU

8:30-10:00 AM
OPEN HOUSE
New Feed Mill and Beef Research Facilities
Coffee

Morning Program 10:00 AM-Noon - Jim Woster, Sioux Falls Stockyards; Presiding

WELCOME! - Gerry Kuhl, Chairman, Extension Livestock Nutritionist, SDSU

FUTURE FOR THE SOUTH DAKOTA CATTLE FEEDER -- Jim Woster

SCABIES -- RE-EMERGING AS A MAJOR CATTLE HEALTH PROBLEM -- Jim Bailey, Extension Veterinarian, SDSU

HEI-GRO INTRAVAGINAL DEVICE AND SYNOVEX-H IMPLANTS FOR FEEDLOT HEIFERS -- Jim Goodman, Dept. of Animal Science, SDSU

FACTORS AFFECTING THE OUTLOOK FOR BEEF CATTLE -- Gene Murra, Extension Agricultural Economist, SDSU

BARBECUED BEEF LUNCH -- Served by Block and Bridle Club, SDSU

Afternoon Program 1:15-4:00 PM - John Ludens, President, South Dakota Livestock Association; Presiding

GOALS OF THE SOUTH DAKOTA LIVESTOCK ASSOCIATION IN 1979 -- John Ludens

SILAGE MAKING AND SILAGE ADDITIVES -- Ken McGuffey, Dept. of Dairy Science, SDSU

BUFFERS IN RUMINANT DIETS -- Royce Emerick, Station Biochemistry, SDSU

SOUTH DAKOTA'S BEEF CATTLE INDUSTRY -- Joe Minyard, Head, Dept. of Animal Science, SDSU

Questions and General Discussion

Animal Science Department
Agricultural Experiment Station
Cooperative Extension Service
South Dakota State University
Brookings

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# SCABIES: RE-EMERGING AS A MAJOR CATTLE HEALTH PROBLEM

James H. Bailey, Extension Veterinarian

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Scabies is a contagious skin disease of cattle caused by tiny parasitic mites that pierce the animal's skin to feed. Discharge from the mite wound oozes onto the surface of the skin to form scabs or crusts.

Cattle with scabies lick, rub, and scratch themselves to relieve intense itching. They lose weight and condition and may be more susceptible to complications such as pneumonia due to lowered vitality.

Scabies was a major problem in the early days of open range grazing of cattle. A vigorous State-Federal program to eradicate the disease brought the condition under control. In 1968, only four cases were reported in the entire United States. During 1978, over 200 cases were diagnosed and premises were quarantined.

During the winter of 1977-78, South Dakota quarantined fourteen infected herds and subsequently dipped them twice to release the quarantine.

So far this year, the number of cases in South Dakota is more than double that of the same date last year causing concern about the future impact of the problem.

## Spread of Cattle Scabies

Direct contact is the most common means of spreading scabies from one animal to another. Scabies-causing mites are also transmitted by infested pens, barns, blankets, brushes, and similar equipment. Often they are unintentionally spread when affected animals are sold or exchanged.

Ordinarily, scabies does not spread from one species of animal to another species. For example, cattle scabies does not spread to sheep.

Cattle do not develop an immunity to scabies. Most animals--whether or not they have already had scabies--readily develop the disease when exposed to scabies mites.

## Signs of Scabies

A "scabby" appearance is the best known sign of scabies. Typical lesions are hard, thick, and gray in color. In advanced cases, scabs may cover large areas of the animal's body.

It is difficult to detect the disease in its early stages before the mites are well established. Affected cattle may seem restless; their hair may be disturbed from increased licking and rubbing. These may be the only signs of scabies until the scabs form.

Affected animals lose hair from scabby areas, and the skin thickens and hardens. Milk production drops. Severely affected cattle stop eating and lose weight or gain less; if not treated, they may die.

## How Scabies Develop

Scabies may occur at any time of the year. Because the mites are most active in fall and winter, scabies is sometimes mistaken for a cold weather disease.

In summer, when the mites are less active, scabs often disappear. Scabby cattle may appear "cured." The improvement, however, is only temporary. If the disease is not detected and treated during the summer, scabs will come back with the return of cold weather.

Scabs normally begin to form 15 to 45 days after the mites get on the host animal. If the mites are not killed, they may spread and form scabs over the entire body of the animal.

## Observing Cattle for Scabies

Make a practice of observing cattle regularly for signs of scabies. Select a location where you can watch the animals without disturbing them.

If you notice restlessness, scratching, rubbing, lesions, or other signs of scabies, examine animals individually. Isolate cattle that have scabies. Consult your veterinarian or a State or Federal disease-control official promptly for expert inspection, diagnosis, and advice.

Watch for constant tail switching, licking, rubbing against objects, scratching, scabby sores, and hair patches on fences.

### If Scabies Mites Are Found:

1. Your premises will be quarantined.

2. All infested and exposed cattle must be dipped in USDA-permitted pesticide under supervision. In South Dakota, only Toxaphene is recognized by the Livestock Sanitary Board.

3. Infested cattle must be dipped twice at 14-day intervals before interstate shipments are allowed.

4. Exposed cattle can move interstate for any purpose after proper treatment. Authorized inspectors who certify animals can advise owners about such interstate shipments.

5. All grounds, barns, corrals, and other areas used by affected cattle must be thoroughly cleaned and disinfected. Spray all exposed surfaces of buildings with a recommended dip or disinfectant.

# FACTORS AFFECTING THE OUTLOOK FOR BEEF CATTLE

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CATTLE FEEDERS DAY

## Supply

During the past two or three years, large supplies of feeder cattle, fed beef and non-fed beef dominated the outlook picture, forcing prices to very low levels. The supply side still dominates the picture but, at least for some aspects of the industry, the affect is a positive one.

The number of cattle on feed is the most significant supply factor, at least for the short-term. While not a strong negative factor, fed beef supplies are at least adequate for the next few months. Encouraged by prices higher than were experienced in most of the past two or three years, cattle feeders placed almost all available feeder cattle in the feedlot. This situation has continued in spite of relatively high costs of feeder cattle, tight and costly credit and somewhat stronger grain prices than some had expected.

Because of the high cost of feeder cattle and fed cattle prices above the cost of gain, another aspect of supply has appeared. Cattle feeders are holding cattle to heavier weights before selling. The combination of large numbers on feed and heavier selling weights should produce a relatively large supply of fed beef, at least for the next few months. Somewhat smaller fed beef supplies are likely later in 1979.

If the above aspects of beef supply were the only ones considered, the result would not be very optimistic. However, other aspects of supply are somewhat more optimistic. And, the other supply factors are strong enough to offset the downward pressure of fed beef supplies. The supply of processing beef is reduced. Cow slaughter is expected to be down considerably. Also, the supply of non-fed steers and heifers should be down as most animals went or will go into the feedlot. Reductions in supply of the processing beef categories will likely offset any increases in the supply of the fed beef categories, especially by mid-1979 or maybe even earlier.

In addition to the internal supply, imports are not expected to have a major impact. The major beef exporting countries are in somewhat the same position as is the U.S. -- a reduced cattle inventory, one ready for some rebuilding.

The net result of the supply factors noted above should be a supply of beef large enough to limit price improvement to only modest increases early in 1979. However, the supply factors are not likely to hold back price increases later in the year.

## Demand

The demand picture is a little cloudy. Talk of a possible slowdown in the economy, a continued high rate of inflation, or both has cause some concern about consumer demand. While beef is still a "good buy", it is an item that is purchased often. And, when the price of a product which is purchased often goes up, the buyer notices quicker than for a product that is purchased less often. Just what action the consumer will take is not clear. Since beef is a good buy, the consumer may continue to buy. Or, some reduction in beef purchases may occur as shifts are made to other protein foods, both meat and vegetable. Or, complaints from consumer groups may cause governmental intervention. Regardless, the price impact of even a lower demand is not expected to offset the impacts from the supply side which were noted earlier.

## Other Factors

One other area, possible governmental intervention, should be noted. Most of the uncertainty about beef prices appears to be in an upward direction. That is, more factors point to higher prices (maybe even extremely higher prices) than there are that point to lower prices. If higher beef prices are noted, especially if an inflationary trend continues, there is the possibility that there will be governmental intervention. This could be either a relaxation of import quotas or imposition of price ceilings. If import quotas were changed, the psychological impact would likely be greater than the actual impact. However, as noted in mid-1978, this could be significant. A price ceiling would have both a psychological and actual impact on prices. While neither of the possible governmental actions is desired by the industry, they certainly must be considered as possibilities.

## Summary

The outlook for beef cattle has more positive aspects than it has negative ones. The net impact of supply is positive. While demand is not easily predicted, it is not expected to have strong negative influences. The major cloud appears to be possible government action.

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# SILAGE MAKING AND SILAGE ADDITIVES

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## Introduction

Silage formation should be considered a "self-preservation" of a feedstuff by fermentation of some of its nutrients by enzymes present in and/or organisms already present on the feedstuff. The resulting product has been defined as "a feedstuff resulting from anaerobic fermentation of moist forage or other feedstuff and by preservation with the formation of acids." Even under ideal conditions of silage formation, nutrient losses will occur during the fermentation process.

The discussion which follows will include suggestions and criteria for making high quality silage with minimum loss of nutrients.

## Fermentation Process

The progression of events from fresh or partially dried forage to the completion of the fermentation process can be predicted. Losses can be estimated with reasonable accuracy when type of material, moisture content and storage conditions are known.

Step 1. Both microbiological and biochemical changes begin immediately as life processes are disrupted when the fresh plant is harvested. Reports suggest that increases in dry matter yield may occur for a short time in the wilting process that follows harvesting because photosynthesis results in carbohydrate storage which can continue for as long as 3 days. Usually, however, such an increase is of no real significance, and a net loss of 1 to 2% dry matter will occur during a 24-hour wilting period as plants continue respiration with utilization of energy. If weather is not favorable for drying during the wilting period, dry matter losses can exceed 10%.

Step 2. Just after the fresh forage enters the silo, fermentation begins with a rapid increase in the bacterial population. If the forage has been properly chopped 1/2 to 3/4 inch (1 to 2 cm) and packed sufficiently to exclude air, the bacterial population will shift to anaerobic (without air) bacteria such as lactobacilli. The continued respiration by the plant cells depletes oxygen that is trapped in the compacted forage and thus contributes to the desired anaerobic condition in the forage mass. Readily available nutrients from the plant cell fluids serve as an energy source for the microbial population. Other than a small amount of hemicellulose sugars, cell wall components (such as cellulose) do not become actively involved in the fermentative activity. Production of organic acids (lactic, acetic and butyric) by microbiological fermentation further restricts the bacterial population to those organisms which are able to tolerate the lower pH (increased acidity). If air has been excluded and anaerobic conditions persist within the fermenting forage, dry matter losses from bacterial activity and plant respiration could be as low as 5 to 6%.

Fermentation is greatest a few hours after the material enters the silo but may continue for a week or more depending on the acidity, compaction, available carbohydrates, moisture level, oxygen present and other factors.

Step 3. Silage will enter a stable phase. During this phase, organic acids produced by fermentation preserve the silage and prevent losses of nturients as long as anaerobic conditions are maintained. The forage mass becomes a palatable feed with good texture and a pleasant odor.

Step 4. If proper silage making practices are not followed, a secondary fermentation by such organisms as clostridia (butyric acid bacilli) may occur which utilize the lactic acid produced in the earlier phases of fermentation. Also, proteins of the forage will be denatured or partially changed to certain nonprotein forms which may not be well utilized by animals. Secondary fermentations may also create undesirable silage odors and possibly toxic nitrogen compounds as well. The temperature of the silage may rise during this secondary fermentation with an accompanying loss of dry matter (as high as 50%). If excessive air enters the mass, yeasts and molds will also use up the acids causing a rise in pH as well as temperature. Animal ingestion of yeasts, high levels of ammonia and mycotoxins from mold activity may present additional hazards. The final result is very bad silage which will not stabilize during storage but will continue to ferment and deteriorate. In addition to serious dry matter losses, such silage will contain more butyric acid, less lactic acid and has been shown to have reduced protein digestibility and energy content than so-called "normal silage."

Characteristics of good silage may be summarized as shown in table 1.

Table 1. Characteristics of Good Silage

| Parameter | |
|---|---|
| pH (acidity) | 4.2 - 4.5 or below |
| Lactic acid | 3 - 5%[a] |
| Butyric acid | 0.1% |
| Ammonia (% of total N) | 10% |
| Temperature | 30-38° C[b] |

[a] Corn and other grain-type silages will usually have higher lactic acid levels than forage-type silages such as alfalfa silage.

[b] Most researchers suggest that silage temperatures should not exceed 38° C (100° F) to avoid browning and protein denaturation. Abnormal silages may reach temperatures in excess of 45° C.

## Factors Affecting Silage Quality

Many of the problems of silage making can be avoided by proper planning for harvest, fermentation and storage. Properly harvested and prepared silage is an excellent feed known for its palatability. Factors such as moisture content and stage of maturity appear to be rather specific for the crop being ensiled.

Maximizing nutrient yield is the goal of any cropping system. In terms of quantity, this refers to dry matter harvested per acre. For example, corn, when harvested for silage, yields more dry matter per acre than many other crops. In terms of maximizing quality, yield refers to harvesting a crop at the correct stage of maturity to obtain a feed with the greatest amount of energy and protein per pound of feed harvested. A good stand of alfalfa will produce high yields of protein per acre.

Harvesting a crop as silage increases the yield of nutrients from the crop as compared to dry hay or forage. In grain crops such as corn or oats, harvesting only the grain leaves 40 to 50% of the available nutrients in the field. Field losses normally associated with dry hays are reduced when harvested for silage. Alfalfa hay, for example, may have field losses of available nutrients in the range of 20 to 30%, whereas field losses of alfalfa silage are less than 10%.

One of the most important keys to making good silage is harvesting the crop at the proper stage of maturity. Crops intended for silage when harvested at the correct stage of maturity will assure maximized yields of digestible nutrients per acre while minimizing field and storage losses.

The following discussion deals with the stage of maturity and moisture content of various ensiled crops to maximize plant and animal production.

### Corn Silage

The proper time to harvest corn for silage is at physiological maturity or when all kernels are fully dented. At physiological maturity, growth ceases and the corn plant yields more dry matter than at any other time in its growing phase. Harvesting after maturity results in leaf loss, dropped ears, stalk breakage and possible weather and insect damage. The whole plant should contain about 30 to 35% dry matter (65 to 70% moisture) which is ideal for compaction within the silo.

The following guidelines will be helpful in determining the time to harvest corn for silage:

1. Start filling the silo when kernels are glazed to hard dent. This usually occurs between 50 to 55 days after silking. By noting when about one-half of the field is in silk one can anticipate ahead of time when harvesting should occur.

2. Use the "black layer" test. At physiological maturity a black layer of cells forms along the tip of the corn kernel. To detect the black layer, remove some kernels from the middle of the ear, split the kernels lengthwise and look for the black layer near the tip. If present, the corn is ready for harvest.

3. Check moisture level in the grain with a moisture tester. Grain will be 65 to 70% dry matter (30 to 35% moisture) when the whole plant is 30 to 35% dry matter.

4. If large tonnages are to be harvested, plant varieties of different maturities. Early maturing varieties should be planted first followed by later maturing varieties. This allows silage harvesting to be spread over a longer period of time and enables the harvesting of all corn at the most correct stage of maturity.

Alfalfa Silage

The recommended time to cut alfalfa for silage is late bud to early bloom stage. At this time leaves make up about half of the dry matter of the plant. Leaves contain greater percentages of protein and energy and less fiber than other plant parts. Cutting at late bud to early bloom results in greatest animal intake, digestibility and annual nutrient yield.

Alfalfa is one of the most difficult crops to ensile successfully. Alfalfa is low in soluble carbohydrates, the substrate required for lactic acid production, and is high in protein and minerals which act as buffering agents to neutralize silage acids and prevents the drop in pH necessary for preservation.

Moisture level is important in making good quality alfalfa silage. Too much moisture (greater than 70%) results in seepage, high levels of butyric acid and protein losses in silage. Too little moisture (less than 45%) results in silage that packs poorly and suffers from heat damage that greatly reduces protein and to a lesser degree dry matter digestibility.

Some steps to follow in making good alfalfa silage are:

1. Cut at proper stage of maturity--late bud to early bloom
2. Wilt to proper moisture level--45 to 70%
3. Chop fine and uniform (1/4 to 3/8 inch theoretical cut)
4. Provide tight silo (especially around doors)
5. Fill silo rapidly and evenly
6. Weight the top of the silage with high moisture material to seal
7. Seal with a cover if not used immediately

Small Grain Silage

Small grains are used extensively for silage in the upper midwest, especially in areas where the growing season is too short for corn. The time to harvest small grains for silage is more critical than for any other crop. Grains mature rapidly after heading, declining in dry matter digestibility at a rate twice that of perennial forage. Data concerning the effect of stage of maturity on voluntary intake and milk production are inconsistent. Higher dry matter yields are obtained with later stages of maturity such as hard dough. However, protein content declines with maturity. Greatest yields of protein per acre occur when harvested at late milk and early dough stages. Seepage is not a problem and sufficient carbohydrates are available for fermentation. Silage from small grains should be chopped fine and evenly distributed in the silo to assure adequate fermentation of the hollow stem.

### Sunflower Silage

Sunflowers are becoming a major crop for part of South Dakota. Much of the sunflowers grown are for seed but can be used for silage. The whole sunflower plant may be 75 to 80% moisture or greater at maturity. One should wait until the plant is approximately 70% moisture before harvesting for silage. Any attempt to wait longer will cause a loss of leaves and possible damage to the heads by birds.

## Silage Additives and Aids to Fermentation

Many attempts have been made to alter, assist or even replace some of the basic steps involved in silage formation by silage additives. For the sake of a more organized discussion of such additives, they will be discussed as belonging to the nutritive or non-nutritive material or as a fermentation inhibitor.

### Nutritive Additions

Molasses. Molasses provides readily fermentable sugars and has found best use with forages that are high in moisture (55 to 88%) and protein (e.g., alfalfa). Molasses has been shown to increase lactic acid content and lower pH, free ammonia and butyric acid content when added (1 to 5%) to grass silages. Molasses also has a drying effect when added to high moisture silage but cannot be expected to stop leeching with the levels of molasses being used. It should not be expected that molasses-treated silages would increase feedlot performance or milk production much above untreated silages. Usually it would not be economical or necessary to add molasses to crops having an adequate level of available carbohydrate such as corn.

Grains. Grains serve a similar function as molasses, although grains do not contain as high a level of simple sugars as molasses. Grains would be higher in dry matter and starch than molasses. Grains such as corn, barley, oats and milo have been added (10 to 20%) to increase fermentable carbohydrates, increase dry matter of wet crops or increase the energy content of the silage. Additions of grains to silage will increase the labor, time required and costs of silage making.

Dried Beet and Citrus Pulp. Dried beet and citrus pulp are not readily available in many areas and are difficult to handle as a silage addition because of the bulky nature of the material. Up to 37% of these materials have been added to silage to increase the dry matter of high-moisture forage. The effect on intake and milk production is small, with only a limited advantage on retention of initial silage dry matter or lowering of silage pH. Pulps could be expected to have less available carbohydrates to increase fermentation as compared to molasses or grains.

Whey. From 1 to 10% dried whey has been added to corn and grass silage with no detrimental effects. In some cases greater digestibility and milk production were obtained by the addition of whey. It has been used as a replacement for molasses with high-moisture forages to assist in greater production of acids. Fresh whey finds less usage since most silages have sufficient moisture content. Some promise is indicated in using whey and low levels of urea to improve milk production when feeding silage. More research is needed to study the value of whey as a nutritive material in silage.

Limestone. Limestone is a very economical additive to silage and can be used to correct the calcium deficiency of corn silage. Limestone may also extend the silage fermentation time and therefore increase the organic acid content. Animal gain and feed requirements may not be benefited by limestone additions. Additions of 0.5 to 1.0% may assist the fermentation somewhat by increasing acid production, especially lactic acid. Minerals of this type, however, can be conveniently provided to animals in mineral supplements rather than by additions to silage.

Urea. Urea is usually added at the 0.5% level (fresh basis) to silage to increase the nitrogen level (protein content) of low protein silage materials such as corn silage. Higher levels may reduce feed intake. The fermentation period may be extended by urea additions to corn silage, but the pH may be higher because of the basic ions formed from urea. Most studies indicate small but beneficial effects on rate of gain, feed efficiency or milk production. Less protein supplementation will be needed with urea-treated silage. If urea and limestone are added together, some claim of associative effects has been suggested over addition of either material alone.

Other Nonprotein Materials and Minerals. Other forms of nitrogen besides urea can be used such as ammonia or ammonia-molasses and mineral suspensions. The response may be similar to urea additions. The choice will depend on which is most convenient to the feeder at the time the silage is made and the cost comparison.

Silages which serve as the only ration--"all-in-one silages"--including nitrogenous additions can be prepared which are customized for a certain feeding regime. Such silages are less flexible once prepared but are more convenient at feeding time. All-in-one silages can be used in automated systems but are more difficult to prepare at ensiling because of the numbers and kinds of materials to be handled. No advantage is realized over supplementing silage as it is fed.

## Non-nutritive Silage Additives

A number of products categorized as "aids to fermentation" are available commercially for addition to forage at the time of ensiling. The function of such aids is to alter the rate or enhance the degree of fermentation and thereby retain a higher proportion of one or more nutrients in the silage dry matter. Although some non-nutritive additives have been the subject of considerable research, others have not been extensively studied under carefully controlled conditions.

This group of additives includes bacterial and yeast inoculants, enzymes, flavorers and antioxidants. The discussion which follows will deal with how they affect fermentation, palatability, preservation of nutrients and animal performance.

Bacterial and Yeast Cultures. The chemical changes observed during the ensiling process result from fermentation by microorganisms which exist naturally on the plant material. These microbes live and grow in an atmosphere of air but, when placed in an oxygen-limiting environment of the silo, some types will disappear. Other microbes will find conditions favorable for growth and will increase to enormous populations. The crushed plant tissue provides an excellent nutrient food for various microorganisms which produce organic acids such as lactic, acetic and propionic acids. The acid fermentation serves to crowd out spoilage producing organisms and aids in the preservation of the silage.

Responses to bacterial inoculants have been variable and somewhat inconsistent. Research has been conducted with wilted or direct cut forages, with forages differing in stage of maturity and with additions of readily fermentable carbohydrates such as molasses, whey or grain. This complicates the evaluation of microbial additives and has created confusion as to their usefulness in silage making.

Investigations with forages inoculated with viable cultures of microorganisms have shown a more rapid decline in pH and a lower pH at the completion of fermentation than untreated forages. Higher titratable acidity has been reported in inoculated silage with increased concentrations of lactic acid and lower levels of acetic and butyric acids. Lower levels of soluble and ammoniacal nitrogen and soluble carbohydrates have been observed.

In terms of preservation, limited research has shown inoculated silages often have a more pleasant aroma with less spoilage than untreated silages. Lower temperatures and improved dry matter and protein preservation have been reported. However, some investigators have found no clear evidence of improvements in these parameters.

The utilization of nutrients by ruminants fed treated forages ranges from small improvements in dry matter and protein digestibility to essentially no changes in utilization. Animal performance with treated and untreated silages has also been variable. Lower intakes of treated silage have been observed with no improvement or only slight improvement in daily gains and feed conversion. Milk production has also been similar for treated and untreated silages. An increase in the fat content of milk has been shown with inoculated forage.

The addition of bacterial inoculants appears to offer little advantage when generous amounts of readily fermentable carbohydrates are present in the silage. Studies with corn silage treated with microbial additives show no effect on weight gain or feed conversion under conditions where increased energy and protein preservation have been observed. Legume or grass silages appear to be improved with the addition of readily fermentable carbohydrates such as sugar or molasses in conjunction with bacterial inoculations.

Enzymes. Enzymes such as proteinase, amylase, cellulose, lipase or crude mixtures of these compounds together with their co-factors have been considered as aids to the silage fermentation process. The mode of action of these additives appears to be their ability to increase the availability of nutrients through factors which stimulate microbial growth or utilization of nutrients by the microbes. The benefits to be obtained, however, depend upon the kind and amount of nutrient to be acted upon by the enzyme. Some investigators suggest that enzymes accelerate fermentation while lowering heat production and increasing the concentration of lactic and propionic acids.

Recent research results with enzyme-treated corn silage show an improvement in preservation and recovery of nutrients compared to untreated silage. However, steers fed the treated silage consumed more dry matter but gained only slightly faster and with only a small improvement in feed efficiency than steers fed the untreated silage.

An investigation of the addition of the enzyme cellulose resulted in an increase of acetic acid with a reduction in lactic acid production. Milk production was not affected in one experiment but was slightly higher in another trial with cows fed silage containing the enzyme.

Flavors. Flavors have been utilized for some time to mask undesirable tastes of feed ingredients or to enhance the aroma of the finished feed. Flavors contribute no nutritional value to a feed or silage. However, some investigators suggest that flavors may impart a desirable aroma to silage and improve feed intake by influencing palatability. However, differences in palatability are extremely difficult to measure. Silage prepared under optimum conditions would not be improved by flavor additions.

Antioxidants. Compounds such as ethoxyquin, butylated hydroxy anisole (BHA), butylated hydroxy toluene (BHT) and others are commonly added to livestock feeds to prevent oxidation of fats, fat-soluble vitamins and pigments. Antioxidants have been included in various additive mixtures for silage presumably to aid in the reduction of oxygen content. Elimination of oxygen in early stages of fermentation would allow bacterial and enzyme reactions involved with fermentative degradation to proceed with greater efficiency. Silage made at the proper moisture content and packed well in the silo would have most of the air removed.

It has been suggested by some investigators that antioxidants may be helpful in reducing heat damage in silage containing optimum moisture. If benefits are to be obtained from antioxidants, the response would occur in early stages of fermentation when organisms which grow without air are rapidly multiplying. Silage made with antioxidants does not appear to keep well with extended periods of storage.

Handling Non-nutritive Additives. The compounds discussed in this section are usually added to the ensilage mass upon storage in the silo. The additives of this group are recommended in very small quantities per ton of forage and therefore some problems of mixing are likely to occur. A quantity such as 1 pound of additive per ton of fresh ensilage requires uniform application and sufficient mixing to insure adequate dispersion throughout the forage mass. Various commercial granular applicators are available which attach to the forage chopper to apply the inoculant near the chopper knives. Applicators may also be mounted on the feed table of the forage blower. Hand mixing may be used by mixing the inoculant with a small quantity of ground corn and then applying the mixture over the top of each load of chopped forage. Storage of additives should be in a cool, dry place, preferably avoiding direct sunlight.

## Fermentation Inhibitors

Another type of silage additive are compounds that inhibit microbial fermentation of silage. There are three classes of fermentation inhibitors: (a) organic acids, (b) mineral acids and (c) antibiotics. Acid addition at ensiling acts by lowering pH in an attempt to prevent microbial growth. Antibiotics have been proposed to selectively inhibit growth of putrefactive bacteria.

Organic Acids. Much of the research on organic acid additions to silage has involved propionic acid, formic acid and formaldehyde as the additive. Formaldehyde is not an acid but acts very similar to formic acid in preserving ensiled material.

Propionic acid was first used as a preservative for high-moisture grain and has been shown to be an effective treatment of silage in terms of reducing silage temperature, top spoilage, mold growth and heat-damaged protein.

Propionic acid (.5 to 2.0%) reduces the amount of heating that occurs in low-moisture alfalfa and the resulting silage has higher protein and dry matter digestibilities than untreated silage. Protein digestibility of propionic-treated alfalfa silage is improved by 5 to 8% over untreated silage. Animal intake as a percent of body weight is increased by 0 to 15% by treating with propionic acid. Although silage quality is improved by addition of propionic acid, animal performance in terms of rate of gain or milk production is not increased by treatment. The primary benefit of treating silage with propionic acid appears to be from increased recovery of dry matter from the silo.

Formic Acid and Formaldehyde. Formic acid and formaldehyde enjoy widespread use in Europe but are not approved by the Food and Drug Administration for use in the United States. Formic acid like propionic acid immediately reduces pH of the ensiled forage. Lactic acid-producing bacteria are relatively tolerant to this acidic condition, whereas other microbes (especially Clostridia) are sensitive to this lowered pH. Theoretically this would give the lactic acid bacteria an advantage to proliferate. Formaldehyde is bactericidal and limits fermentation.

Addition of formic acid or a mixture of formic acid and formaldehyde to legumes or grasses results in silages (direct cut or wilted) with lower pH, butyric acid and total acids, higher lactic acid and greater residual soluble carbohydrates than in untreated controls. Formaldehyde alone produces silage with a higher pH but less total acids than controls. Greater amounts of true protein and less ammonia were present in formic acid and formaldehyde-treated silage than in untreated silage.

Energy digestibility of silage treated with formic acid, formaldehyde or a mixture is similar to control. Nitrogen digestibility of formaldehyde-treated silage may be lower than that of untreated silage. Although digestibility is less, nitrogen utilization is improved for two reasons: (1) more nitrogen in forage present as true protein and (2) protein in formaldehyde-treated forages tends to by-pass rumen fermentation and be digested in the lower tract.

Animal performance, the best indicator of forage quality, is improved from 20 to 60%, feed intake is increased by 10 to 15% and feed efficiency is improved 50 to 80%.

Mineral Acids. Mineral acids (hydrochloric, sulfuric and phosphoric) when added to silage cause an immediate fall in pH of 3.8 to 4.0. At this low pH, the forage (this would not be a true silage) would be preserved almost indefinitely. One of the major problems with mineral acid silage is animal intake is extremely low. Use of mineral acids as a preservative cannot be recommended because of cost and its corrosive nature.

Caution in Handling Acids. Care must be taken when treating a crop with a product containing any organic acid. Acids are corrosive and look like water. They can easily be mistaken for water and used improperly. An acid product should be clearly labeled and, when using acids, have plenty of water and sodium bicarbonate (baking soda) near to clean up spills and accidents immediately. Wear protective clothing, especially goggles for the eyes. When finished, machinery should be washed and sprinkled with baking soda to neutralize any remaining acid.

Antibiotics. Work with antibiotics advanced on the theory that growth of selected microorganisms could be inhibited during early stages of fermentation while other more desirable microbes would grow and increase in numbers. Antibiotics such as tylosin, zinc bacitracin, tetracyclines and streptomycin have been used with little success in improving silage quality.

## Summary and Conclusions

The production of high quality silage is a problem that is costly in terms of possible loss of nutrients, reduced palatability and a reduction of total feed available due to dry matter losses. The adherence to time-tested principles is still the best assurance of obtaining high quality silage that has an appealing color, pleasant smell and good texture. Good quality silage is most likely accomplished by:

1. Harvesting the crop at the correct stage of maturity.

2. Chop fine (1/4 to 1/2 inch) and keep equipment in top operating condition.

3. Make sure silo is in good repair. Doors are tight and do not leak.

4. Fill silo continuously if possible.

5. Distribute evenly and pack well.

6. For upright silos, make last loads wet to add extra weight for packing.

7. Cover the top of the silage.

# BUFFERS IN RUMINANT DIETS

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There are two sets of dietary conditions under which the beef feeder may give consideration to the feeding of buffering materials. One is when the diet consists primarily of silages that by necessity contain preformed organic acids in quantities that may contribute an extra burden to the normal buffering capacity of the ruminant digestive tract. The other is under conditions of high-concentrate feeding when the rapid fermentation of readily fermentable carbohydrates by rumen microbes produces high concentrations of organic acids. These acids may overtax the normal buffering systems inherently present in the ruminant digestive tract and blood system resulting in the condition commonly referred to as rumen acidosis.

## Feeding Buffering Materials With Silages

It has been estimated that 13 to 30% of the energy requirements of the ruminant are supplied through metabolism of volatile fatty acids (Bentley *et al*., 1956). While these acids are generally the product of rumen fermentation, some ruminant feeds such as those from fermented high-moisture feeds (silage, haylage, high-moisture corn, etc.) supply important quantities of preformed organic acids. On a dry matter basis, some silages have been found to contain in excess of 7% volatile fatty acids (Barnett, 1954). In the past, some researchers have successfully added mixtures of organic acids to ruminant diets. However, these have been found not to be consumed as readily as diets containing the salts of these acids (Essig *et al*., 1959).

Studies at other experiment stations have indicated that the intake of silages may at times be limited by their acidity. A 9 to 20% increase in dry matter intake from ryegrass silage was reported to be associated with partial neutralization of the acidity with sodium bicarbonate (McLeod and Wilkins, 1970; McLeod *et al*., 1970). Reversal of the buffer treatment through the use of lactic acid resulted in consumption of the silage at about the same level as for untreated silage. Sodium chloride which would have essentially no effect on the pH of silages also had no effect upon the amount of silage consumed.

Kansas researchers (Brethour and Duitsman, 1975) obtained increases in dry matter intake and weight gain with steers fed high-silage diets supplemented with 100 g of sodium bicarbonate daily. South Dakota researchers in reports given at earlier Cattle Feeders Days (Embry and Dye, 1970; Embry *et al*., 1968, 1969) reported that, when fed at the rate of 90 g per head daily, sodium bicarbonate gave a 7 to 10% improvement in weight gain during a 113-day feeding period; limestone had no effect and calcium hydroxide gave variable results.

## Feeding Buffers With High-Concentrate Diets

### Causes of Acidosis

A period of 2 to 4 weeks is normally required for adaptation of ruminants to high-concentrate diets. During that time the animal is more susceptible to "overfeeding" which may result in a generalized condition commonly referred to as acidosis. Consumption of large quantities of readily fermentable carbohydrates, such as those found in high-concentrate diets, beyond the rumen's normal fermentation capacity results in a rapid drop in pH and subsequent rapid growth of microorganisms producing lactic acid. An adapted microbial population, on the other hand, resists lactic acid build-up through competitive inhibition of lactic acid forming microbes and the growth of other microbes that utilize lactic acid.

Poor management is probably the greatest causative factor in acute ruminal acidosis. The most common management problems include making dietary changes too rapidly, irregular feeding and self-feeders that are empty a day or two before being detected. Beneficial results from the feeding of buffers during an initial 21 to 28 days of high-concentrate feeding have been high. However, the feeding of buffers to beef cattle and sheep following adaptation has generally shown little, if any, effect.

South Dakota researchers have used sodium bentonite, described as a naturally occurring montmorillonite clay, sodium bicarbonate and limestone in high-concentrate diets for lambs and/or beef cattle. While lambs have been suggested to be more prone to death losses from acidosis, experimental results from our work utilizing lambs are likely to be applicable to beef cattle.

### Sodium Bentonite and Sodium Bicarbonate

Lambs brought to a full feed slowly over a period of 12 days appeared to respond optimally to 4% of sodium bentonite in a study involving 0 to 12% sodium bentonite added to an 80% concentrate diet (Huntington et al., 1977a). In that study, average daily gain in the 4% sodium bentonite group was doubled in the initial 28 days while feed consumption was increased only 5%. Although fed for a total of 110 days, bentonite provided no apparent benefit beyond the initial 28-day adaptation period.

Another study (Huntington et al., 1977b) compared 2 and 4% levels each of sodium bentonite and sodium bicarbonate. The lambs were brought to full feed over a period of 8 days using an 80% concentrate diet. Instead of the dust grade sodium bentonite used in the previous study, feed grade crumbles were used resulting in less refusal of fine materials. Under these circumstances, 2% sodium bentonite proved to be an optimum level increasing average daily gain by 78% and feed consumption 8.5% during the initial 21 days. Two percent sodium bicarbonate gave a 37% increase in average daily gain and a 3% increase in feed intake during that period. However, the 4% level of sodium bicarbonate proved to be too high offering no improvement. Over the longer term of the 98-day feeding period, neither sodium bentonite nor sodium bicarbonate offered any significant improvement in performance and the 4% level of each reduced performance.

These results prompted further attempts to improve performance during the later phases of the feeding period by decreasing the buffer level following a 21-day adaptation (Dunn et al., 1979). Lambs were placed on a full feed of a 92% concentrate diet without prior adaptation to concentrates. Severe acidosis occurred in a majority of the lambs on the third day and a death loss of 19% occurred in the control group. Two percent of either sodium bentonite or sodium bicarbonate reduced the severity of acidosis with a reduction in death losses to 3%. When fed in combination, 2% of the bentonite plus 2% of the bicarbonate, death losses were completely prevented. A trend toward higher (18.6% increase) average daily gain was observed for this combination treatment group. Reducing the buffer concentration to one-half of the previous levels in one group of the lambs and deleting it entirely in the other group showed no advantage for continued buffer feeding (for the remainder of the 75-day feeding period).

Beef steers were placed on a full feed of 92% concentrates by increasing the ration uniformly over a period of 4 days using the 2% buffer treatments described for lambs above (Dunn et al., 1979). No deaths occurred and again a trend toward improved weight gains during the initial 28 days was associated only with the combination 2% sodium bentonite plus 2% sodium bicarbonate treatment. Continued feeding of the buffers at the lower 1% level tended to reduce average daily gain during the remainder of the feeding period.

Based upon earlier work at the South Dakota Agricultural Experiment Station (Hoar et al., 1967) concerning the relationships of alkali-forming materials to occurrence of phosphatic urinary calculi, a word of caution appears to be in order. The feeding of sodium bicarbonate, especially in conjunction with elevated levels of dietary phosphorus, has regularly provided increases in urinary mineral deposits in most of the South Dakota studies described above. In some instances these have resulted in an increased incidence of urinary blockage (water belly).

## Limestone

Limestone (calcium carbonate) is regularly incorporated into beef and lamb finishing diets to meet calcium requirements. We have conducted a study with lambs (Dunn et al., 1977) where limestone was fed at levels of 1 to 4% of the diet above that required to meet calcium requirements. They were placed on a full feed of a 92% concentrate diet without prior adaptation to concentrates. A death loss of 25% in the controls due to acidosis was reduced only by the highest level of limestone. However, the death loss still remained relatively high at 10%. Feed intake and average daily gain were increased by all levels of limestone during the initial 21 days. Although there were no significant differences in average daily gain during the remainder of the 121-day feeding period, animals fed the 1% level of limestone appeared to maintain a weight gain advantage that amounted to 18% over the controls at the end of the feeding period. Other workers (Wheeler and Noller, 1976) have shown limestone to affect pH to the greatest extent in the small intestine of ruminants, providing a more optimum pH for the action of the enzyme amylase that digests starch. They reported undigested starch excreted in feces of ruminants to be less for animals consuming supplemental limestone.

Alfalfa Hay

An area that remains inadequately explored is the potential buffering effect of alfalfa hay in ruminant diets. A recent report of data from New Mexico (Anonymous, 1978) showed that offering alfalfa hay free-choice to calves being placed on high levels of concentrates significantly reduced death losses and increased feedlot performance. However, similar to the effects of buffers, these effects were said to be significant only during the first 2 weeks of feeding. In studies (South Dakota State University) where comparisons were made with all-concentrate diets and low levels of hay, most beneficial effects of hay occurred during the first few weeks of the experiments. In the most recent South Dakota study with lambs, the usual brome or mixed hay as had been used in previous studies was unavailable and was replaced with an excellent quality alfalfa hay. Lambs receiving an 8% alfalfa hay (92% concentrate) diet experienced no death losses when placed on full feed without prior adaptation and showed no improvement in initial performance in response to bentonite and/or limestone treatments.

It is concluded that buffers may be of some benefit in the feeding of high-silage diets and during adaptation to high-concentrate diets. Their value following adaptation appears to be limited in feedlot lambs and cattle. However, digestive problems and death losses that may occur at infrequent intervals when cattle and sheep have free access to high-concentrate diets might be reduced by feeding buffering compounds. These may be minor from an experimental standpoint but could be of major economic importance.

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# OAT HAY OR OAT HAYLAGE IN HIGH ROUGHAGE RATIONS


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A.S. Series 79-1

In a previous experiment (A.S. Series 77-12) cattle fed oat haylage (48.4% dry matter) stored in a concrete stave silo gained at a faster rate and more efficiently than those fed baled oat hay (88.2% dry matter). Harvesting losses in dry matter were higher for hay, but losses in storage were higher for the haylage. Net cattle gains were 24% more from haylage than from hay harvested from essentially equal land areas.

Forage yields were low in the previous experiment because of a low seeding rate and drought conditions. However, grain content in relationship to forage was good and the amount of grain in the forage dry matter was estimated to be about 40%.

Oat forage may vary considerably between years in yield and in chemical composition. Therefore, it was considered advisable to repeat the experiment under similar conditions to obtain more information on the comparative value of an oat crop harvested as hay or haylage.

## Procedures

Forty-eight steers (37 Herefords and 11 Hereford crosses) were used in the experiment. They were allotted into eight pens of six each to be similar on the basis of weight and breeding. Oat hay was fed to four pens of the cattle and oat haylage to the other four pens.

Two fields of oats were harvested for the experiment. Forage yields were similar (about 2 tons dry matter per acre). Grain yield was low in relationship to the amount of forage because of rust infestation and hail damage to the crop. The grain varied considerably in stage of maturity at harvest--from boot to hard dough stages--because of the hail damage. It was recognized that there would be a low yield of light weight grain but there would be a good yield of forage.

An equal number of windrows, uniformly distributed over each field, were chopped for haylage and for hay. That for haylage was chopped from one field on July 8, 1978, and from the other field on July 12.

The forage harvested as hay was dry chopped from the field on July 15, 18 and 19. Light showers resulted in the delay in chopping but was not considered to cause any appreciable weather damage.

Chopped forage was hand separated into forage and grain. Upon basis of this separation, the dry matter yield as grain was 17%. Test weight of the separated grain was 26 lb. per bushel. These values appear to check closely with estimated yield and quality of grain in the standing crop.

The haylage was stored in an 18 foot x 50 foot upright concrete stave silo. The field chopped hay was stored under cover in a hay shed. Dry matter content as chopped was 40.05% for the haylage and 86.18% for the hay. Total protein contents for haylage and hay, dry basis, were 11.77 and 11.97%.

The cattle were fed hay or haylage in amounts so feed would be available at all times. Feeding was once daily. The only other feeds offered were free-choice trace mineral salt and a calcium-phoshorus supplement. The experiment was terminated for each group of cattle when their supply of forage was exhausted.

## Results

Results of the experiment are in table 1. The experiment was started on July 20 and was terminated on April 14 (268 days) for the hay group and on June 17 (332 days) for the haylage group. The winter was a severe one for feeding cattle outside without shelter. Obviously, the rations were low in energy for weight gains typical of backgrounding operations under weather conditions experienced. However, results represent comparisons of the two forages under those conditions.

### Feedlot Performance

A major difference between the two forages was in feed consumption. Steers fed the haylage consumed an average of approximately 5 lb. less dry matter daily than those fed the hay. In the previous experiment from mid-July to late November with similar initial weight of cattle, there was about equal dry matter consumption between oat hay and oat haylage (53% dry matter as fed). The haylage contained less dry matter in the current experiment. Greatest differences in dry matter consumption between hay and haylage occurred during the colder months when feed intake did not increase as much for haylage as for hay.

Weight gains were low and feed requirements were high for this long experiment. Average daily gain in mid-October (86 days) under favorable weather conditions was 1.75 lb. for the haylage group and 1.64 lb. for the hay group. Daily dry matter consumption during this time averaged about 15.7 and 16.5 lb., respectively, for haylage and hay. This rate of gain was somewhat lower than in the previous experiment. The forage in the current experiment was considerably lower in amount of grain dry matter (17%) than in the previous one (40%). A lower protein content (slightly less than 12% in comparison to about 16.5% in the previous experiment) may have also been a factor in the lower performance.

Negative weight gains were encountered on weigh days in mid-November and mid-December. The November weigh day was a few days after the early November blizzard. Weight gains remained at rather low levels through mid-March. However, the average daily gain for the haylage group was slightly greater than for the hay group throughout the experiment even with the lower dry matter intake. The higher rate of gain with the lower intake of feed dry matter resulted in a substantial improvement in feed efficiency for haylage over hay (34.8%, dry basis).

## Haylage and Hay Comparisons

Procedures used in harvesting for haylage and hay were considered to have resulted in uniform areas in size and forage yield. Dry matter yield of haylage exceeded that for hay by 5.8%. This difference between haylage and the field chopped hay was similar as obtained between haylage and baled hay the previous year.

Dry matter content of samples taken at feeding throughout the experiment averaged 86.87% for hay and 43.62% for haylage. There was essentially no change from dry matter at harvest for hay but an increase of 3.57 percentage units for haylage.

Loss in dry matter between storing and feeding amounted to only 0.65% for hay but 10.16% for haylage. Dry matter losses of this order are not uncommon during several months of storage for silage crops in upright concrete stave silos. Harvesting losses were less for the haylage, resulting in a net difference of 4.3% less dry matter fed from haylage.

Cattle gains per ton of dry matter stored were 83 lb. for haylage and 54 lb. for hay. These are rather low gains and considerably less than in the previous experiment (163 lb. for haylage and 141 lb. for hay). Total cattle gains from similar areas harvested were 5900 lb. for haylage and 3974 lb. for hay. On the basis of total gains, the haylage had a value of 148% that of hay.

## Summary

Results of our experiments show that under good harvesting weather slightly more dry matter is recovered from oat forage harvested as haylage than hay. The difference was in the order of 6 to 7% whether the hay was baled or field chopped at about 86% dry matter.

Hay stored under cover, baled or chopped, had only small losses in storage. Haylage dry matter losses during storage in a concrete stave silo were 10 to 12%.

Yearling steers (about 675 lb.) gained faster and more efficiently when fed oat haylage than when fed oat hay. Differences encountered amounted to 24% in one experiment and 48% in another on the basis of forage dry matter harvested from similar areas.

Results of the research show an advantage for oat haylage over oat hay. Results indicate considerable variation may be encountered. Likely factors involved are grain content of the forage, quality of the grain, protein content of forage and conditions of feeding as to weather and cattle. The advantage for haylage may be increased as these factors become less favorable for optimum production. However, more research is needed in order to adequately evaluate effects of these factors.

Table 1. Oat Hay and Oat Haylage for Growing Cattle
(July 19, 1977, to April 14 or June 17, 1978)

| Item | Oat hay | Oat haylage |
|---|---|---|
| No. animals | 24 | 23 |
| Days fed | 268 | 332 |
| Avg init. shrunk wt., lb. | 677 | 676 |
| Avg final shrunk wt., lb. | 842 | 924 |
| Avg daily gain, lb. | .62 | .75 |
| Avg daily feed, lb. | | |
| As fed | 26.3 | 40.9 |
| Dry basis | 22.9 | 17.8 |
| Feed/100 lb. gain, lb. | | |
| As fed | 4263 | 5535 |
| Dry basis | 3703 | 2414 |
| Composition of forage, % dry basis | | |
| At harvest | 86.18 | 40.05 |
| As fed | 86.87 | 43.62 |
| Total protein | 11.97 | 11.77 |
| Dry matter stored | | |
| Pounds | 148,066 | 156,706 |
| Percent of hay[a] | -- | 105.8 |
| Dry matter fed | | |
| Pounds | 147,110 | 140,777 |
| Storage loss, % | .65 | 10.16 |
| Percent of hay | -- | 95.7 |
| Cattle gain from forage | | |
| Per ton feed, lb. (DM) | 54 | 83 |
| Percent of hay | | 154 |
| Per ton stored, lb. | 54 | 75 |
| Percent of hay | | 139 |
| Total cattle gain, lb. | 3974 | 5900 |
| Percent of hay | | 148 |

[a] Hay used as base and assumed to be 100.

# WHOLE OR ROLLED CORN GRAIN FED AT VARIOUS LEVELS TO CATTLE ON PASTURE

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Results of several experiments with drylot finishing of cattle have shown little, if any, advantage for processing corn grain on basis of weight gain and feed efficiency when rations contain 80% or more grain dry matter. At lower levels there has generally been some advantage from processing the grain.

Various levels of grain are frequently fed to growing and finishing cattle on pasture. Levels may vary from a few pounds daily to free access to grain. Questions are then raised as to the benefits of processing the grain and how the benefits might be affected by the levels fed.

Two experiments are reported here when cattle were fed various levels of corn grain on pasture. Comparisons were made between corn fed whole and rolled.

## Procedures

The same pasture area was used for the two experiments. It was established in 1968 and has been grazed at about maximum stocking rates each pasture season since that time. The pasture area was seeded for a stand of about equal parts of alfalfa and grasses (bromegrass and intermediate wheatgrass). It has been fertilized in early spring of most years with a typical application being about 125 lb. of 18-46-0 per acre. Management procedures have appeared to maintain the desired proportions of alfalfa and grasses.

Levels of corn grain fed per head daily were 0 (control), 4 lb., 8 lb. and a full feed. Each level was replicated four times for 16 paddocks of cattle. For those fed corn, it was fed whole in two paddocks and rolled for the other two at each level.

For the first experiment, 64 Hereford steers were allotted into the 16 paddocks with four head each. For the second experiment, 80 Hereford heifers were used with five per paddock. Acres per paddock provided were 5 for the no grain control and 4-lb. groups, 3.75 for the 8-lb. group and 2.5 for those full fed.

Each paddock was subdivided to allow for rotational grazing. Grazing procedures used during the 2 years were to allow the cattle access to one of the subdivided plots at the beginning of the grazing season. When the other side had reached an adequate growth for a hay crop, it was harvested. After a short recovery period, the cattle were then given access to this area, thereby doubling the grazing area for the remainder of the season. Ample forage appeared to be provided throughout the season.

Cattle in all paddocks fed corn were offered 4 lb. per head initially. The grain was increased at a rate of 1 lb. daily to the 8-lb. level for this group and until grain remained in the feed bunks at the next feeding for the full-fed group. Grain feeding in the 1978 experiment was started after the cattle had been on pasture for 34 days. A wet early season made alleyways impassable with the feeding experiment during this time.

Grain was offered once daily in feed bunks located near watering tanks. Trace mineral salt and a calcium-phosphorus supplement were offered free access. The steers were implanted with Synovex-S and the heifers with Synovex-H.

## Results

### 1977 Experiment

Results of this experiment with steers are presented in table 1 for effects of levels of corn feeding and in table 2 for comparisons between whole and rolled grain.

The response in weight gain increased with increasing levels of corn but was quite low in comparison to the no grain control for the levels of grain consumed.

Steers fed the rolled corn gained at a faster rate than those fed whole corn. The differences were small when corn was fed at only 4 lb. per head daily. When fed at 8 lb. daily or full fed (avg 17.60 and 17.06 lb.), the advantage in weight gain amounted to 12 and 11% for the rolled grain. Feed efficiency would be improved to a similar degree as rate of gain since corn intake was held constant at the fixed levels and varied only slightly when full fed.

### 1978 Experiment

Results of this experiment with heifers are presented in table 3 for effects of levels of corn feeding and in table 4 for comparisons between whole and rolled grain. Daily intake shown is the average for the 133-day experiment even though corn was not fed during the first 34 days on pasture. Treatment levels designated are for the levels of grain offered during the time fed, but levels of intake shown during the experiment are at lesser amounts.

The response in weight gain increased with increasing levels of corn fed as in the 1977 experiment with steers. Again, the response in amount of gain over the no corn group was low for the levels of grain consumed.

Heifers fed rolled corn gained at a faster rate and more efficiently than those fed whole corn. Some differences from the 1977 experiment were observed, but this is to be expected because of the small number of cattle involved each year, differences in cattle and yearly effects.

## Summary and Comments

Results of the two experiments show a relatively small response in weight gain by steers and heifers fed grain on pasture at daily levels of 4 lb., 8 lb. or a full feed (about 17 lb. for steers and about 12 lb. for heifers) in comparison to no grain controls. Rates of gain increased with increasing levels of grain and would, therefore, reduce days needed for drylot finishing following the pasture season.

Increasing levels of grain could be expected to reduce consumption of pasture forages which was not measured in these experiments. The decrease in forage consumption would mean more animals could be stocked per acre and would result in a lower pasture charge per animal.

Rolled corn grain resulted in faster weight gains than did whole corn within the levels fed in these two experiments. The average improvement for the 4-lb., 8-lb. and full-fed levels (about 12 or 17 lb. daily) was 12%. There was no consistent difference between levels of grain in the two experiments.

The results of the two experiments show an average of about 12% more weight gain for rolled corn over whole corn when fed at similar daily levels. If type of corn fed had no effect on pasture forage consumption, the cost of the increased amount of gain would be that for processing the corn.

Table 1. Levels of Grain for Pasture Feeding
(Steers: May 17 to October 20, 1977--156 days)

| | No grain | 4 lb. per head daily | 8 lb. per head daily | Full fed |
|---|---|---|---|---|
| No. animals | 16 | 16 | 16 | 16 |
| Init. shrunk wt., lb. | 655 | 653 | 653 | 650 |
| Final shrunk wt., lb. | 822 | 868 | 885 | 1000 |
| Avg daily gain, lb. | 1.07 | 1.37 | 1.48 | 2.24 |
| Avg daily corn, lb. | -- | 3.93 | 7.72 | 17.33 |
| Corn/100 lb. gain, lb. | -- | 286 | 521 | 775 |
| Gain over no grain group per lb. of corn consumed, lb. | -- | .076 | .053 | .068 |

Table 2. Whole or Rolled Corn Grain Fed at Various Levels on Pasture
(Steers: May 17 to October 20, 1977--156 days)

| | 4 lb. per head daily | | 8 lb. per head daily | | Full fed | |
|---|---|---|---|---|---|---|
| | Whole | Rolled | Whole | Rolled | Whole | Rolled |
| No. animals | 8 | 8 | 8 | 8 | 8 | 8 |
| Init. shrunk wt., lb. | 655 | 651 | 655 | 652 | 648 | 651 |
| Final shrunk wt., lb. | 866 | 869 | 873 | 897 | 980 | 1019 |
| Avg daily gain, lb. | 1.35 | 1.40 | 1.40 | 1.57 | 2.12 | 2.36 |
| Percent from whole | | 104 | | 112 | | 111 |
| Avg daily ration, lb. | 3.92 | 3.94 | 7.68 | 7.76 | 17.60 | 17.06 |
| Feed/100 lb. gain, lb. | | | | | | |
| Whole or rolled corn | 291 | 281 | 548 | 494 | 828 | 723 |
| Percent from whole | | 97 | | 90 | | 87 |

Table 3. Levels of Grain for Pasture Feeding
(Heifers: June 8 to October 19, 1978--133 days)

| | No grain | 4 lb. per head daily | 8 lb. per head daily | Full fed |
|---|---|---|---|---|
| No. animals | 20 | 20 | 20 | 20 |
| Init. shrunk wt., lb. | 557 | 561 | 562 | 556 |
| Final shrunk wt., lb. | 709 | 737 | 767 | 817 |
| Avg daily gain, lb. | 1.14 | 1.32 | 1.54 | 1.96 |
| Avg daily corn, lb. | -- | 2.98 | 5.88 | 11.89 |
| Corn/100 lb. gain, lb. | -- | 226 | 382 | 609 |
| Gain over no grain group per lb. of corn consumed, lb. | -- | .060 | .068 | .069 |

Table 4. Whole or Rolled Corn Grain Fed at Various Levels on Pasture
(Heifers: June 8 to October 19, 1978--133 days)

| | 4 lb. per head daily | | 8 lb. per head daily | | Full fed | |
|---|---|---|---|---|---|---|
| | Whole | Rolled | Whole | Rolled | Whole | Rolled |
| No. animals | 10 | 10 | 10 | 10 | 10 | 10 |
| Init. shrunk wt., lb. | 561 | 560 | 562 | 563 | 559 | 554 |
| Final shrunk wt., lb. | 725 | 749 | 760 | 74 | 792 | 843 |
| Avg daily gain, lb. | 1.23 | 1.42 | 1.49 | 1.59 | 1.75 | 2.17 |
| Percent from whole | | 115 | | 107 | | 124 |
| Avg daily corn, lb. | 2.98 | 2.98 | 5.88 | 5.88 | 11.27 | 12.51 |
| Corn/100 lb. gain, lb. | 243 | 209 | 395 | 70 | 644 | 575 |
| Percent from whole | | 86 | | 94 | | 89 |

# METHODS OF VITAMIN A SUPPLEMENTATION FOR FATTENING BEEF CATTLE

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A.S. Series 79-3

CATTLE FEEDERS DAY

Rations consisting of corn grain and limited high protein hay such as alfalfa appear to be satisfactory for fattening beef cattle from about 700 lb. to slaughter weights without additional protein supplementation. The intake of carotene, a precursor to vitamin A, could be relatively low under these conditions; and, therefore, a vitamin A supplement would be indicated. Methods of supplementing vitamin A other than through a daily supplement may provide a more practical and economical means of administration. Feeding vitamin A in a free-choice mineral supplement or administering the vitamin as a large one-time injection offers certain convenience and labor-saving advantages to the cattle feeder.

The objective of this experiment was to study the effects of administering vitamin A through a mineral supplement or injection on feedlot performance and liver storage of vitamin A. The feeding trial was conducted at the James Valley Agricultural Research and Extension Center near Redfield during the summer and fall of 1977. The present study also involved a comparison of conventionally-dried, solar-dried and acid-treated corn. Feedlot performance results for these treatments have been reported in the 1978 Progress Report of the Center.

## Procedure

Sixty steers averaging 741 lb. were used in the experiment. The steers were ear-tagged, weighed and allotted to six pens of ten steers each. The steers were implanted with 36 mg zeranol at the start of the trial. Initial and final weights were recorded following an overnight stand without feed or water.

The steers were fed either conventionally-dried corn, solar-dried corn or acid-treated corn and 2 lb. of good quality, chopped alfalfa-bromegrass hay. Three pens of steers were allowed free-choice consumption of a mineral mixture containing 65.3% ground limestone, 34.3% trace mineral salt and .4% vitamin A palmitate premix. The vitamin A concentration in the final mixture was calculated to be 546,000 International Units (IU) per pound. Mineral intake was expected to be about 9 g per day based on past observations at this location which would provide approximately 11,000 IU of vitamin A per steer daily. Free-choice mineral was placed in salt boxes equipped with a partial cover.

Three pens of steers were allowed a mineral mixture without vitamin A. These steers were administered 2 million IU of vitamin A as an intramuscular injection at the beginning of the feeding period. This amount would provide a level equivalent to 20,000 IU of vitamin A per steer daily for an expected feeding period of about 100 days.

Supplies of the different corns allowed the experiment to continue for a total feeding period of 138 days. The cattle were weighed following an overnight stand without feed and water and the experiment was terminated. The cattle were fed conventionally-dried corn about a month longer to reach a desirable slaughter weight and quality. Samples of liver tissue were collected at slaughter and frozen for carotene and vitamin A analysis.

## Results

The results of vitamin A supplementation are shown in table 1. Weight gains and feed data may be of limited value in evaluating the effects of vitamin A supplementation. Weight gains of cattle fed rations low in vitamin A and carotene are not usually affected to any appreciable degree until body stores are sufficiently depleted and feed intake decreases. However, small differences in performance were observed. Gains of cattle receiving the vitamin A supplement by injection were slightly higher than those of cattle allowed vitamin A in a free-choice mineral supplement. The injected cattle consumed slightly more feed and required less feed per unit of gain than cattle allowed the free-choice mineral.

Mineral consumption for the six pens of cattle averaged about 31 g (range 30 to 34 g between the six pens) per steer daily during the 138-day experiment. This resulted in a vitamin A consumption of about 38,000 IU per steer daily. An average daily dose of injected vitamin A was calculated to be equivalent to 14,500 IU for the feeding period of 138 days.

Carotene and vitamin A concentrations in liver tissue are presented in table 2. The levels indicated adequate vitamin A nutrition for the feeding conditions of this experiment. Vitamin A storage was slightly higher for the cattle receiving the injection. The cattle were held about a month beyond the feeding experiment which may have resulted in lower liver vitamin A levels than at the end of the fattening period. Higher liver stores might have been expected for steers receiving vitamin A in a free-choice mineral supplement because of the higher estimated vitamin A intakes. However, some destruction of vitamin A by mineral elements in the mineral mixture may have occurred, resulting in somewhat lower vitamin A intakes than those which were calculated. Recent stability studies with a vitamin A-trace mineral mixture show vitamin A potency losses of over 60% during a 12-week period under conventional storage conditions. Concentrations of vitamin A in the mineral mixture were not determined during the study.

## Summary

Yearling steers were fed a low-carotene ration in a 138-day feeding trial to compare two methods of vitamin A supplementation. Vitamin A was included in a mineral mixture offered free-choice or as a single massive dose injected intramuscularly at the start of the feeding period. The steers were fed a full feed of whole shelled corn and a limited amount of hay. This ration would not provide sufficient carotene to support adequate vitamin A nutrition. Both methods of vitamin A supplementation resulted in comparable weight gains and feed conversion. Concentrations of carotene and vitamin A in liver tissue were slightly higher for cattle receiving the vitamin A injection in comparison to the free-choice mineral treatment in

which vitamin A intake was more than two times greater. However, neither method of administering vitamin A appeared to allow appreciable liver storage.

Supplementation of vitamin A through a free-choice mineral mixture can present some problems when voluntary intake of mineral is low and variable. In this experiment the steers consumed larger quantities of mineral than expected and this resulted in greater vitamin A intake. Mineral elements in such mixtures may cause considerable destruction of vitamin A, resulting in reduced potency. The data suggest that levels of vitamin A provided through a free-choice mineral supplement need to be considerably greater than amounts by injection as measured by liver storage.

Table 1. Methods of Supplementing Vitamin A to Finishing Beef Cattle
(May 18 to October 3, 1977--138 days)

| | Free-choice mineral | Injection |
|---|---|---|
| No. animals | 30 | 29[a] |
| Avg init. wt., lb. | 741 | 738 |
| Avg final wt., lb. | 1093 | 1105 |
| Avg daily gain, lb. | 2.55 | 2.66 |
| Avg daily feed, lb. (as fed basis)[b] | | |
| Whole corn | 18.82 | 18.93 |
| Chopped hay | 2.49 | 2.49 |
| Mineral mixture | .07 | .06 |
| Total | 21.38 | 21.48 |
| Feed/100 lb. gain, lb. | | |
| Whole corn | 738 | 712 |
| Chopped hay | 98 | 94 |
| Mineral mixture | 3 | 2 |
| Total | 839 | 808 |

[a] One steer died of unknown causes.
[b] A small quantity of whole oats was fed at the start of the trial.

Table 2. Carotene and Vitamin A Concentrations in Liver Tissue

| | Free-choice mineral | Injection |
|---|---|---|
| No. animals | 30 | 29 |
| Carotene, mcg/100 g | | |
| Conventionally-dried corn | 2.36 | 2.34 |
| Acid-treated corn | 2.21 | 2.58 |
| Solar-dried corn | 2.11 | 2.14 |
| Average | 2.23 | 2.35 |
| Vitamin A, mcg/100 g | | |
| Conventionally-dried corn | 4.19 | 4.20 |
| Acid-treated corn | 6.52 | 9.50 |
| Solar-dried corn | 4.60 | 5.31 |
| Average | 5.10 | 6.34 |

CATTLE FEEDERS DAY

# HEI-GRO INTRAVAGINAL DEVICE AND SYNOVEX-H IMPLANTS FOR FEEDLOT HEIFERS

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A.S. Series 79-4

Recently considerable publicity has been given to an intravaginal device (Hei-Gro) as a means of improving weight gain and feed efficiency of feedlot heifers. A need for research with the Hei-Gro device for feedlot heifers was indicated.

Another concern in feeding of heifers is pen position in relation to steers. It has been advocated that heifers should be separated from steers by as much as 40 feet. Research is not adequate to support this recommendation. However, it could be a matter of some practical concern in feeding operations involving both steers and heifers.

The research reported herein was conducted to evaluate the Hei-Gro device when used alone and in combination with Synovex-H implants. In addition, the experiment was designed to study effects of pen position in relation to steers on feedlot performance of heifers.

## Procedures

Ninety-six Hereford heifers were used in the experiment which was divided into a growing phase and a finishing phase. The cattle were allotted into 16 pens of six each after stratifying on basis of weight. Experimental treatments were control, Synovex-H, Hei-Gro intravaginal device and Synovex-H plus Hei-Gro.

One row of eight pens was adjacent to steers separated by a 16-foot feeding alley. The other row of eight pens was isolated from steers by the 16-foot feeding alley, the row of heifers (32 feet) and a 16-foot work alley. The other side of this row of heifers was an open area. Each heifer treatment group was represented twice in each row (referred to as isolated and nonisolated), so there were two pens of six heifers from each treatment group isolated from and adjacent to steers (16-foot alley separation). Heifers and steers were not fed in adjacent pens in the experiment.

Implanting with Synovex-H and inserting the Hei-Gro devices were done following allotment for the experiment. The initial ration for all pens during the growing phase on an as fed basis was reconstituted alfalfa haylage, 79.8%; rolled corn grain, 15.3%; and supplement, 4.8%. The supplement was corn-based with added minerals, vitamin A and monensin. After 63 days of the growing phase, oat haylage replaced the alfalfa haylage and was fed at the same level.

Three randomly selected heifers from each pen were rectally palpated weekly to monitor ovarian size and structure to study cyclic activity.

For the finishing phase, no changes were made in allotment or pen assignments. Those implanted with Synovex-H initially were reimplanted at the beginning of the finishing phase.

The ration during the finishing phase was rolled corn grain, 74.2%, oat haylage, 18.9%, and supplement, 6.9%, on an as fed basis. The supplement was soybean meal-based (about 32% protein) with added minerals, vitamin A and monensin.

Observations were made for signs of estrus during the first 21 days of the finishing phase. Pens were checked frequently for loss of the Hei-Gro devices. When found or detected missing during palpation, a new device was inserted.

Upon termination of the experiment, the heifers were slaughtered at a local packing plant. Carcass data were obtained and reproductive tracts collected for examination.

## Results

Size of heifers and type of ration could have an effect on response to the treatments involved in the experiment. Therefore, results are presented separately for the growing phase and the finishing phase.

### Growing Phase

Results of the 112-day growing phase are shown in table 1. The average initial weight of 516 lb. exceeded the minimum weight (450 lb.) recommended for devicing of heifers.

Table 1. Feedlot Performance of Growing Beef Heifers
(May 11 to August 31, 1977--112 days)

| Item | Control | Synovex-H | Hei-Gro | Hei-Gro + Synovex-H |
|---|---|---|---|---|
| No. animals | 24 | 24 | 24 | 24 |
| Init. shrunk wt., lb. | 514 | 516 | 517 | 516 |
| Final shrunk wt., lb. | 730 | 749 | 706 | 746 |
| Avg daily gain, lb. | 1.93 | 2.07 | 1.69 | 2.05 |
| Avg daily dry matter intake, lb. | 15.0 | 15.6 | 14.0 | 15.2 |
| Feed/lb. gain, lb. | 7.77 | 7.54 | 8.28 | 7.41 |

Heifers implanted with Synovex-H gained at a faster rate (7.25%) than did the control group. They consumed slightly more feed and had a small advantage (3.03%) in feed efficiency.

Heifers which received the Hei-Gro device gained at a lower rate (12.44%), consumed less feed and had higher (6.82%) feed requirements in comparison to the control group.

Heifers which received both Synovex-H implants and the Hei-Gro device performed in a similar manner as to weight gain, feed consumption and feed efficiency as those which received only the Synovex-H implants.

Average daily gain and feed efficiency as affected by pen position in relation to steers are shown in table 2.

Table 2. Effect of Growth Stimulants and Location on Performance of Growing Beef Heifers (May 11 to August 31, 1977--112 days)

| | Nonisolation[a] | | Isolation[a] | |
|---|---|---|---|---|
| Treatment | Average daily gain, lb. | Feed/gain[b] | Average daily gain, lb. | Feed/gain |
| Control | 2.03 | 9.18 | 1.83 | 9.04 |
| Synovex-H | 2.07 | 8.83 | 2.07 | 8.76 |
| Hei-Gro | 1.79 | 9.38 | 1.61 | 10.00 |
| Hei-Gro + Synovex-H | 1.96 | 8.97 | 2.14 | 8.42 |
| Average | 1.96 | 9.09 | 1.91 | 9.06 |

[a] Averages of 12 animals per treatment.
[b] Dry matter basis.

Average performance for the eight pens adjacent to steers and the eight pens isolated from steers was about the same. There were some small differences between isolated and nonisolated heifers within treatment groups. These data represent only two pens of six heifers each and, therefore, provide limited data for evaluating position effects.

No differences in cyclic activity were detected among any of the treatments as determined by rectal palpation during this phase of the experiment.

## Finishing Phase

Following the growing phase, the heifers were changed to the high-grain finishing ration over a period of about 10 days. Feedlot performance during this 100-day phase is shown in table 3.

Table 3. Effect of Growth Stimulants on Finishing Beef Heifers (August 31 to December 9, 1977--100 days)

| Item | Control | Synovex-H | Hei-Gro | Hei-Gro + Synovex-H |
|---|---|---|---|---|
| No. animals | 24 | 24 | 24 | 24 |
| Init. shrunk wt., lb. | 730 | 748 | 706 | 746 |
| Final shrunk wt., lb. | 902 | 939 | 868 | 937 |
| Avg daily gain, lb. | 1.72 | 1.91 | 1.61 | 1.89 |
| Avg daily dry matter intake, lb. | 17.2 | 18.7 | 16.1 | 18.5 |
| Feed/lb. gain, lb. | 10.0 | 9.79 | 10.0 | 9.79 |
| Carcass wt., lb. | 541 | 563 | 522 | 568 |
| Dressing percent | 59.9 | 59.9 | 60.1 | 60.6 |
| Quality grade[a] | 19.2 | 19.2 | 19.7 | 18.9 |
| Fat thickness, inches | .55 | .58 | .53 | .48 |
| Rib eye area, sq. in. | 9.9 | 11.2 | 10.6 | 11.3 |

[a] Quality grades are coded: 18 = high good; 19 = low choice; 20 = average choice.

Rate of gain was similar during this phase as during the growing phase even though the ration was higher in energy. Heifers implanted with Synovex-H gained at a faster rate than controls. The advantage was some greater (11.05%) than during the growing phase. Synovex-implanted heifers again consumed more feed but varied only slightly (2.42%) from controls in feed efficiency.

Heifers which received the Hei-Gro device gained at a lower rate in comparison to controls. The reduction was less (6.40%) than during the growing phase. They consumed less feed but had about the same feed requirements as the controls.

Hei-Gro with Synovex-H resulted in similar performance as for Synovex-H.

Carcass data (table 3) show some differences between treatment groups. Some of these would be reflections of differences in rate of gain and carcass weight. None of these differences were statistically significant.

Weight gain and feed efficiency as affected by position in relation to steers are shown in table 4. The eight pens of heifers isolated from steers had an average daily gain greater (8.82%) than for the eight pens fed adjacent to steers. Examination of the data by treatment groups would indicate that any advantage from isolation occurred only with Synovex-H. However, small numbers of animals were involved (two pens of six) in these comparisons and the interaction of position and treatment was not statistically significant. One might also question the apparent lack of response to Synovex-H in comparison to controls in the nonisolated group. Further comparisons would appear desirable.

Examination of reproductive tracts revealed substantial differences among treatments. Heifers with the Hei-Gro device had significantly more vaginal scarring and infection in comparison to those without the device. Infection was more severe when the device was used with Synovex-H implants.

Table 4. Effect of Growth Stimulants and Location on Performance of Finishing Beef Heifers (August 31 to December 9, 1977--100 days)

| | Nonisolation[a] | | Isolation[a] | |
|---|---|---|---|---|
| Treatment | Average daily gain, lb. | Feed/gain[b] | Average daily gain, lb. | Feed/gain |
| Control | 1.69 | 10.56 | 1.74 | 9.50 |
| Synovex-H | 1.67 | 11.20 | 2.13 | 9.34 |
| Hei-Gro | 1.72 | 9.67 | 1.50 | 9.59 |
| Hei-Gro + Synovex-H | 1.74 | 10.32 | 2.02 | 9.26 |
| Average | 1.70 | 10.44 | 1.85 | 9.42 |

[a] Averages of 12 animals per treatment.
[b] Dry matter basis.

## Summary and Comments

Results of the experiment show that feedlot performance of heifers was improved by Synovex-H implants during both growing and finishing phases. The Hei-Gro device appeared to offer no improvement over controls. Neither did Hei-Gro plus Synovex-H offer any improvement over Synovex-H.

Isolation of heifers from steers appeared to have no effect during the growing phase of the experiment. Results were more variable during the finishing phase. Any advantage from isolating heifers from steers appeared to be for heifers implanted with Synovex-H. However, numbers were small and the Synovex treatment resulted in essentially no response in the non-isolated group in the experiment. In view of this, results appear inconclusive regarding effects of isolating heifers from steers. Also, comparisons were not made with heifers and steers in adjacent pens. Further comparisons would be desirable.

Treatments appeared to have no effect on cyclic activity of the heifers. The Hei-Gro device resulted in considerable scarring and infection of the vagina.

Loss rate of the device was high. During the course of the experiment, 43.8% of the heifers lost one or more devices which were replaced when discovered. Six of the 48 deviced heifers were without the Hei-Gro device at slaughter.

# COMPARISON OF METHODS OF PRODUCING SLAUGHTER WEIGHT STEERS USING MAXIMUM QUANTITIES OF FORAGE AND MINIMUM QUANTITIES OF GRAIN

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CATTLE FEEDERS DAY

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## Introduction

The probability of high grain prices and/or a shortage of grain for livestock feeding due to human competition has created a need for reevaluation of finishing cattle with a minimum use of grain. By necessity, cattle feeding may become more dependent upon range and pasture forage. Therefore, rangelands may again be looked to as a source of slaughter cattle.

The majority of the semi-arid and arid rangelands of the west have no alternate use for food production other than through grazing. It is important that our ranges and meadowlands be utilized to the fullest extent for meat production which will conserve feedstuffs that can be consumed directly by man. Production of a slaughter weight animal, which is acceptable to the consumer, utilizing a maximum quantity of forage and a minimal quantity of grain is needed to insure that beef will continue to be an economical protein source for the consumer.

The objectives of this study were to compare performance and slaughter characteristics of various production systems by which slaughter steers can be produced in the high desert rangeland of eastern Oregon, which is very similar to the semi-arid rangelands of western South Dakota. Economic analysis and taste panel evaluations are also included.

## Materials and Methods

Trial 1. Sixty Hereford steers, with an equal number from each of four winter treatments, were assigned to a growing and finishing study on May 11, 1976. Steers were stratified by previous winter treatment and randomly allotted to one of three growing phase treatments. Thirty-six steers were assigned to a crested wheatgrass range and 24 split between alfalfa-fescue and clover-fescue irrigated pastures.

Steers on the range treatment, during the growing phase, were moved to a fresh pasture when they had utilized about 35% of the available forage as determined by visual observation. A supplemental feeding program for yearlings on crested wheat developed over a period of years on the Squaw Butte Station was used as a base (Raleigh, 1970). Table 1 shows the daily supplemental nutrient intake of the steers on range. Energy and nitrogen were supplied by barley and biuret, respectively. Careful attention was given to hand feeding the supplement at the same time each morning in order to maintain maximum grazing time and performance. Steers on irrigated pasture were alternated between two pastures, approximately 2 acres in size. Steers were moved every two weeks to allow for irrigation and regrowth. These animals received 3.2 pounds of barley per head through July 28 at which time barley was gradually increased to 5 pounds by August 3.

The finishing phase began August 3 at which time 10 steers from the range treatment and five from each irrigated pasture treatment were assigned to the feedlot. One-half of the steers placed in the feedlot received a 40% roughage (38% rye grass straw, 2% alfalfa) based ration with cottonseed meal (CSM) as the source of protein. The other half received basically the same ration with dried poultry waste (DPW) and feathermeal as the protein source. These rations are shown in table 2. Steers were slaughtered when back fat reached .3 inches as measured by ultrasonic means and carcass data were collected.

TABLE 1. DAILY SUPPLEMENT INTAKE ON RANGE

| Period | Biuret (lb.) | Barley (lb.) |
|---|---|---|
| 5/11-6/15 | .0 | 1 |
| 6/16-6/17 | .03 | 1 |
| 6/18-6/19 | .04 | 1 |
| 6/20-6/26 | .05 | 1 |
| 6/27-7/3 | .09 | 1 |
| 7/4-7/10 | .10 | 1.3 |
| 7/11-7/17 | .12 | 1.6 |
| 7/18-7/24 | .14 | 1.8 |
| 7/25-8/3 | .14 | 2.5 |

TABLE 2. FEEDLOT RATIONS FOR STEERS, TRIALS 1 AND 3

| Ingredient | CSM (lb.)[b] | DPW (lb.)[b] |
|---|---|---|
| Straw, rye grass | 750 | 750 |
| Alfalfa | 50 | 50 |
| Molasses | 150 | 150 |
| Tallow | 50 | 50 |
| Rolled barley | 764 | 773 |
| Cottonseed meal | 225 | --- |
| Dried poultry waste | --- | 185 |
| Feather meal | --- | 40 |
| Limestone | 9 | --- |
| Antibiotic | 1 | 1 |
| Vitamin A premix[a] | 1 | 1 |
| Total | 2000 | 2000 |

[a] 2 million IU/lb.

[b] CSM and DPW are cottonseed meal and dried poultry waste rations, respectively.

Steers remaining on crested wheatgrass range and irrigated pasture received increasing amounts of grain at the rate of .5 pound every two days until they reached a full feed of grain, using the pastures and range as a roughage source. When the level of grain reached 8 pounds daily per head, the steers were fed half their daily allowance morning and evening. Composition of rations for the finishing phase are shown in table 3. It was necessary to feed grass hay to steers on irrigated pasture the last 31 days after frost stopped growth. The steers were slaughtered beginning November 6, prior to the onset of cold weather which reduces feed efficiency. The ten heaviest range steers were slaughtered at this time. The ten heaviest steers from irrigated pasture treatments were slaughtered November 13 and the next ten heaviest animals on range were slaughtered November 20. Carcass data were collected on each of these animals.

TABLE 3. FINISHING RATIONS FOR STEERS ON IRRIGATED PASTURE AND RANGE, TRIALS 1 AND 2

| Ingredient | Irrigated Pasture (lb.) | Range (lb.) |
|---|---|---|
| Rolled barley | 1961 | 1937 |
| Biuret | 8 | 25 |
| Salt | 20 | 16 |
| Limestone | 10 | 21 |
| Vitamin A premix[a] | 1 | 1 |
| Total | 2000 | 2000 |

[a]2 million IU/lb.

Sensory panel evaluations were made on the <u>longissimus</u> muscle from the 9-10-11-12th rib section of five randomly chosen carcasses from each treatment. The cuts were placed in plastic bags, the air evacuated, over wrapped with freezer paper and frozen whole. Just prior to cooking and sensory evaluations, the frozen cuts were removed from the freezer. As thin a full cut as possible was taken from the small end and then three one-and-one-quarter inch steaks were cut. The steaks were cooked in the frozen form by broiling ten minutes on each side at which time thermocouples were inserted into the middle of the steak and broiling continued with turning every five minutes until an internal temperature of 71 C was reached. Warm samples (two per cut) were served to individual panelists on a ten member trained taste panel. Tenderness, flavor, aroma, juiciness and overall desirability were determined.

<u>Trial 2</u>. Thirty-nine Hereford and Hereford X Angus steers were assigned to a growing and finishing study on May 17, 1977. Eighteen head were allotted to crested wheatgrass range, 10 head to alfalfa-fescue irrigated pasture and 11 head to alfalfa orchardgrass irrigated pasture. Steers were managed and fed as in trial 1, except the steers on irrigated pasture received 2.5 pounds of barley daily per head.

The finishing phase began August 3 at which time nine steers from range, five from alfalfa-fescue and six from alfalfa orchardgrass irrigated pasture were allotted to one of four feedlot treatments. Each of the feedlot treatments was a 40% roughage based ration of either 5% alfalfa hay plus 35% annual rye grass straw (ARS), 35% perennial rye grass straw (PRS), 35% wheat straw (WS), or 35% grass hay (GH) (table 4).

The nine steers remaining on crested wheatgrass range were managed and fed as in trial 1. The 10 steers remaining on irrigated pasture were placed in drylot and fed long meadow hay *ad libitum* with the grain ration fed as in trial 1. Composition of steer rations for range and irrigated pasture were the same as fed in trial 1 (table 3). The steers from the irrigated pasture study were removed for slaughter on November 6. The crested wheatgrass steers were removed on November 20. Sensory panel evaluations were conducted as previously described.

*Trial 3*. Thirty Hereford and Angus X Hereford steers born in the fall of 1975 were assigned to various growing and finishing treatments at weaning time, July 28, 1976. Ten steers were assigned to go to the feedlot immediately, five of which were placed on the CSM ration and five on the DPW ration (table 2). The remaining steers were allotted to irrigated pasture until October 12. At this time ten went to the feedlot where half were placed on the CSM ration, the rest on the DPW ration. These treatments will be referred to as IP-CSM and IP-DPW.

TABLE 4. FEEDLOT RATIONS FOR STEERS, TRIAL 2

| Ingredient | ARS(lb.) | PRS(lb.) | WS(lb.) | GH(lb.) |
|---|---|---|---|---|
| Annual rye grass straw | 350 | | | |
| Perennial rye grass straw | | 350 | | |
| Wheat straw | | | 350 | |
| Grass hay | | | | 350 |
| Alfalfa | 50 | 50 | 50 | 50 |
| Rolled barley | 683 | 683 | 683 | 683 |
| Feather meal | 25 | 25 | 25 | 25 |
| Cottonseed meal | 25 | 25 | 25 | 25 |
| Tallow | 50 | 50 | 50 | 50 |
| Molasses | 150 | 150 | 150 | 150 |
| Limestone | 14 | 14 | 14 | 14 |
| Tricophos | 1 | 1 | 1 | 1 |
| Rumensin premix[a] | 1 | 1 | 1 | 1 |
| Vitamin A premix[b] | 1 | 1 | 1 | 1 |
| Total | 1000 | 1000 | 1000 | 1000 |

[a]20 g/lb.

[b]2 millionIU/lb.

The other ten steers were assigned to be fed approximately two-thirds alfalfa hay and one-third meadow hay through the winter period in drylot. They also received 1 pound of barley per head each day the last 90 days in the lot. On May 18, 1977, they were placed on crested wheatgrass range until July 17, at which time they were removed for slaughter. While on crested wheat they received 2 pounds of barley daily per head plus biuret as prescribed by the supplement schedule of table 1. This treatment is referred to as IP-SB-CW. Carcass data were collected for all five treatments.

## Results and Discussion

Trial 1. Performance and economic analysis of steers during the 84-day growing phase are shown in table 5. Steers grazing the crested wheatgrass range gained faster ($P < .05$) than either group on irrigated pasture on approximately one-third the grain. It is possible that increased gains could have been obtained by feeding more concentrate (Perry *et al.*, 1972). However, successive increments of grain usually return less gain per additional unit as shown by Denham (1977).

TABLE 5. GAIN AND CONSUMPTION DATA FOR 84-DAY GROWING PHASE OF TRIAL 1

| Item | Irrigated Pasture | | Range |
|---|---|---|---|
| | Alfalfa-fescue | Clover-fescue | Crested wheat |
| No. of steers | 12 | 12 | 36 |
| Initial wt., lb. | 440 | 442 | 436 |
| Daily gain, lb. | 2.4 | 2.4 | 3.3* |
| Daily gain intake, lb. | 3.3 | 3.3 | 1.3 |
| Grain/gain ratio | 1.4 | 1.4 | .4 |
| Economic Analysis | | | |
| Receipts | | | |
| Feeder steers, $[a] | 205.22 | 204.59 | 225.05 |
| Expenses | | | |
| Growing steers, $[b] | 176.00 | 176.88 | 174.24 |
| Feed cost, $[c] | 36.34 | 36.34 | 26.99 |
| Total expense, $ | 212.34 | 213.22 | 201.23 |
| Returns to capital, land, labor and management, $ | -7.12 | -8.63 | 23.82 |

*Significant ($P < .05$).

[a]Valued at 32¢/lb.

[b]Valued at 40¢/lb.

[c]Barley at 5.5¢/lb. Forage at $7.50 per steer month.

Returns to capital, land, labor and management were greatest for the range steers. Fewer management problems were encountered with range steers than those on irrigated pasture due to fewer parasite and health problems.

Steers finished on irrigated pasture gained faster than those finished in the feedlot (table 6). Daily feed intake, which did not include grass for the range or irrigated pasture treatments, was nearly twice as much in the feedlot. The additional 11 pounds of feed required per head per day in the feedlot illustrates the contribution of the pastures for finishing the range and irrigated pasture steers. Utley and McCormick (1976) reported that the use of pasture decreased grain consumption by 39% as compared to the drylot. By finishing steers on range and irrigated pasture, a savings of 190 pounds of grain was made as compared to finishing under this type of a feedlot program. The actual savings is somewhat greater as 17 days of feed are not accounted for in the feedlot treatments. This period was allowed for steers to recover from transport and get back on feed. This illustrated another advantage of finishing on range as the range cattle do not go through a period of being off feed.

Weather conditions dictate the length of time cattle can remain on pasture, thus, restricting the feeding period and body weights attainable. This is illustrated in the heavier carcass weights of the feedlot animals which received an additional 27 days of feed as recorded plus the 17 days prior to the finishing phase beginning. Carcass grades were also higher from the feedlot which may also be due to the additional days on feed and not the type of feed. Fat color of the carcasses from irrigated pasture were more yellow than those from the range or feedlot. Rib eye areas were not significantly different among treatments. Beef from the feedlot group was more desirable in all factors of the taste panel evaluation except in aroma where no differences occurred. The overall desirability of cattle in the DPW feedlot treatment was greater than the CSM treatment.

TABLE 6. PRODUCTION AND CARCASS CHARACTERISTICS FOR FINISHING PHASE IN TRIAL 1

| Item | Irrigated Pasture | | Range | Feedlot[f] | |
|---|---|---|---|---|---|
| | Alfalfa-fescue | Clover-fescue | Crested wheatgrass | CSM | DPW |
| No. of steers | 6 | 6 | 25 | 10 | 10 |
| Initial wt., lb. | 662 | 664 | 706 | 726 | 724 |
| Daily gain, lb. | 3.0 | 3.0 | 2.5 | 2.0 | 2.2 |
| Daily feed intake, lb.[a] | 5.11 | 5.11 | 5.47 | 9.07 | 10.57 |
| Feed/gain ratio | 3.76 | 3.79 | 4.71 | 9.97 | 10.36 |
| Days on feed | 103 | 103 | 103 | 130 | 130 |
| Carcass characteristics | | | | | |
| 24 hr. carcass wt., lb. | 519 | 524 | 557 | 607 | 625 |
| Carcass grade[b] | 7.6 | 8.2 | 9.2 | 10.3 | 10.1 |
| Marbling score[c] | 3.20 | 3.4 | 3.75 | 4.1 | 4.1 |
| Rib eye area, in. | 9.6 | 10.5 | 9.5 | 10.3 | 10.3 |
| Fat color[d] | 2.6 | 2.4 | 3.5 | 4.0 | 4.4 |
| Taste panel evaluation[e] | | | | | |
| Aroma | 4.62 | | 4.58 | 4.37 | 4.37 |
| Tenderness | 3.95 | | 4.47 | 5.63 | 6.35 |
| Juiciness | 4.69 | | 4.83 | 5.45 | 5.94 |
| Flavor | 4.86 | | 4.94 | 5.81 | 6.20 |
| Overall desirability | 4.31 | | 4.70 | 5.61 | 6.31 |

[a]Intake does not include forage for irrigated pasture and range treatments.

[b]13 = medium choice, 10 = medium good, 7 = medium standard.

[c]4 = slight, 3 - traces.

[d]4 = slight yellow tinge, 3 = slightly yellow, 2 = moderately yellow;

[e]Scored on a scale of 1 to 8 with 8 being most desirable.

[f]CSM and DPW are cottonseed meal and dried poultry waste treatments respectively.

Trial 2. Performance characteristics and economic analysis of the growing phase are shown in table 7. The daily gains were much less than gains of steers in trial 1. Steers used in trial 2 were approximately 165 pounds heavier at the beginning, due to higher winter gains, than the animals of trial 1. The lighter animals of trial 1 exhibited compensatory growth which boosted their daily gains. The steers on the alfalfa-fescue irrigated pasture treatment gained the least as compared to the other two treatments. The steers on crested wheatgrass received approximately half the amount of supplement as those on irrigated pasture. Returns to capital, land, labor and management were again the highest for the range steers.

Production and carcass characteristics for the finishing phase are shown in table 8. Daily gain on crested wheatgrass was less than the other treatments. The irrigated pasture steers which were finished on meadow hay fed free choice in the lot had greater daily gains than those on range. Raleigh *et al.* (1967) reported that steers finished in drylot being fed meadow hay *ad libitum* gained more than the range-fed group. Days on feed for the feedlot treatments would have been 30 days longer except that the cattle went off feed and the trial was restarted at the point when they were back on feed again, thus the difference in initial weight. This inflated the daily gains of the feedlot steers, as the time the steers were recovering from shipment and getting back on feed was omitted. Daily feed and hay intake of the steers from irrigated pasture was greater than any of the 40% roughage rations in the feedlot. However, the steers from irrigated pasture consumed over half of their diet as roughage. A savings of 132 pounds of grain per head was possible by finishing steers in the feedlot as compared to range and irrigated pasture.

Carcass weights were again heavier from steers out of the feedlot. No significant difference was found in carcass grade or marbling score. The ARS and PRS carcasses had larger rib eye areas than either the alfalfa-orchardgrass or the crested wheatgrass treatments. Fat color was somewhat more desirable in the feedlot treatments. Overall desirability of the beef from the crested wheat treatment was lowest. This effect was due primarily to the range beef being less tender than the other treatments. Tenderness scores of this beef were considerably less (3.93 vs 4.47) than that of trial 1.

TABLE 7. GAIN AND CONSUMPTION DATA FOR GROWING PHASE OF TRIAL 2

| Item | Irrigated Pasture Alfalfa-fescue | Irrigated Pasture Alfalfa-orchardgrass | Range Crested wheat |
|---|---|---|---|
| No. of steers | 10 | 11 | 18 |
| Initial wt., lb. | 618 | 596 | 620 |
| Daily gain, lb. | 1.5 | 2.0* | 2.0* |
| Daily gain intake, lb. | 2.5 | 2.5 | 1.3 |
| Grain/gain ratio | 1.6 | 1.2 | .6 |
| No. days | 76 | 76 | 78 |
| Economic Analysis | | | |
| Receipts | | | |
| Feeder steers, $[a] | 233.94 | 237.72 | 247.77 |
| Expenses | | | |
| Growing steers, $[b] | 216.37 | 208.82 | 217.29 |
| Feed cost, $[c] | 29.47 | 29.47 | 25.26 |
| Total expense, $ | 245.84 | 238.29 | 242.55 |
| Returns to capital, land, labor and management, $ | -11.90 | -.57 | 5.22 |

*Significant ($P < .05$).

[a] Valued at 32¢/lb.

[b] Valued at 35¢/lb.

[c] Barley at 5.5¢/lb. Forage at $7.50 per steer month.

TABLE 8. PRODUCTION AND CARCASS CHARACTERISTICS FOR FINISHING PHASE, TRIAL 2

| Item | Irrigated Pasture AF | Irrigated Pasture AO | Range CW | Feedlot ARS | Feedlot PRS | Feedlot WS | Feedlot GH |
|---|---|---|---|---|---|---|---|
| No. of steers | 5 | 5 | 9 | 5 | 5 | 5 | 5 |
| Initial wt., lb. | 741 | 750 | 781 | 838 | 845 | 851 | 865 |
| Daily gain, lb. | 2.9 | 2.9 | 1.8 | 2.6 | 2.3 | 2.2 | 2.3 |
| Daily feed intake, lb.[a] | 11.4 | 11.4 | 12.0 | 17.5 | 16.9 | 15.7 | 19.9 |
| Daily hay intake, lb. | 12.5 | 12.5 | | | | | |
| Feed/gain ratio | 8.1 | 8.2 | 6.4 | 6.6 | 7.2 | 7.1 | 8.8 |
| Days on feed[b] | 99 | 99 | 108 | 87 | 78 | 83 | 64 |
| Carcass Characteristics | | | | | | | |
| 24 hr. carcass wt., lb. | 554 | 572 | 552 | 640 | 616 | 620 | 607 |
| Carcass grade[c] | 7.6 | 9.4 | 9.0 | 10.6 | 9.4 | 9.4 | 10.0 |
| Marbling score[d] | 3.0 | 3.8 | 3.8 | 4.2 | 3.8 | 3.8 | 4.0 |
| Rib eye area, in. | 10.5 | 9.8 | 9.7 | 11.3 | 11.7 | 10.8 | 10.7 |
| Fat color[e] | 3.0 | 3.0 | 3.0 | 3.4 | 3.6 | 3.4 | 4.0 |

[a] Feed intake only includes grain for the irrigated pasture and range treatments.

[b] Feedlot cattle went off feed for 30 days which is not accounted for.

[c] 10 = medium good, 7 = medium standard.

[d] 4 = slight, 3 = traces.

[e] 4 = slight yellow tinge, 3 = slightly yellow.

[f] AF, AO, CW, ARS, PRS, WS and GH are alfalfa-fescue, alfalfa-orchardgrass, crested wheatgrass, annual rye grass straw, perrenial rye grass straw, wheat straw and grass hay treatments respectively.

TABLE 8. (continued)[f]

| Item | Irrigated Pasture | | Range | Feedlot | | | |
|---|---|---|---|---|---|---|---|
| | AF | AO | CW | ARS | PRS | WS | GH |
| Taste panel evaluation[g] | | | | | | | |
| Aroma | 5.93 | | 5.90 | 5.34 | 5.42 | 5.56 | 5.36 |
| Tenderness | 4.61 | | 3.93 | 5.26 | 4.48 | 5.84 | 4.68 |
| Juiciness | 5.26 | | 5.03 | 5.26 | 5.12 | 5.18 | 5.16 |
| Flavor | 5.68 | | 5.53 | 5.64 | 5.44 | 5.60 | 5.34 |
| Overall desirability | 4.94 | | 4.57 | 5.32 | 4.80 | 5.06 | 5.10 |

[f]AF, AO, CW, ARS, PRS, WS and GH are alfalfa-fescue, alfalfa orchardgrass, crested wheatgrass, annual rye grass straw, perrenial rye grass straw, wheat straw and grass hay treatments respectively.

[g]Scored on a scale of 1 to 8 with 8 being most desirable.

Trial 3. Production and carcass data for fall calves are shown in table 9. Daily gains of steers on the IP-SB-CW treatment were less than the other four treatments. Total days on feed were considerably longer as would be expected on an all forage diet. No significant differences were detected among treatments for carcass weight, grade or marbling score. Rib eye areas of the CSM and DPW treatments were largest. Fat color score of the IP-SB-CW treatment was less than the other treatments.

The steers on the IP-SB-CW treatment received less than .75 pounds of barley daily. The steers in the other treatments consumed 10 pounds or more of grain per day. Thus, the savings in grain alone amounted to 9.25 pounds per day or enough to have finished 10 more steers. By utilizing the irrigated pasture before going to the feedlot the IP-CSM and the IP-DPW treatments required 40 days less to finish than the CSM or DPW treatments, a savings of 436 pounds of grain.

The three studies presented in this paper show that a substantial savings of grain can be made utilizing forage finishing systems, particularly when compared to conventional finishing systems feeding 80% grain rations. Livestock and Meat Situation[1] reports that typical Great Plains custom feeders feed 3300 pounds of grain to 600 pound steers for six months. The range and irrigated pasture systems reported in this study utilized 770 pounds of grain to finish 715 pound steers. This is a savings of 2530 pounds of grain over the conventional finishing system.

Daily gains were greater on crested wheatgrass range as compared to irrigated pastures for the growing stage. Returns to land, labor, management and capital were also greatest for the range treatment.

Carcass grades fell in the high standard to good grade for all treatments. Brady (1957) found that the public prefers beef of U.S.D.A. good grade and would buy more of it, as compared to choice or prime grades, if it were available. Kidwell *et al*. (1959) found that carcass grade does not have a great deal of influence on taste and acceptance of meat. Acord (1977) stated that consumers will need to learn how to appreciate the advantages of meat that carries relatively little fat and, therefore, grades "Good" instead of "Choice". Overall desirability of the beef from the feedlot treatments was greater than the range of irrigated pasture treatments but all were acceptable. Schupp *et al*. (1976) reviewed research results from state experiment stations evaluating the acceptability of forage-finished and limited grain-finished beef and found forage-finished beef to be acceptable in each case.

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[1] Livestock and Meat Situation, Economic Research Service, U.S. Department of Agriculture, LMS-217, October 1977.

TABLE 9. PRODUCTION AND CARCASS DATA FOR FALL CALVES, TRIAL 3

| Item | Range[d] | Feedlot | | | |
|---|---|---|---|---|---|
| | IP-SB-CW | CSM | DPW | IP-CSM | IP-DPW |
| No. of steers | 10 | 5 | 5 | 5 | 5 |
| Initial wt., lb. | 676 | 575 | 556 | 645 | 638 |
| Daily gain, lb. | 1.45* | 2.2 | 2.0 | 2.0 | 1.9 |
| Daily feed intake, lb. | 18.6 | 16.6 | 17.7 | 18.0 | 19.3 |
| Feed/gain ratio | 12.8 | 7.6 | 8.5 | 9.0 | 10.3 |
| Days on feed | 252 | 191 | 199 | 133 | 148 |
| Carcass Characteristics | | | | | |
| 24 hr. carcass wt., lb. | 561 | 594 | 579 | 545 | 550 |
| Carcass grade[a] | 9.7 | 8.4 | 10.2 | 9.4 | 10.0 |
| Marbling score[b] | 3.9 | 3.6 | 4.4 | 3.8 | 4.0 |
| Rib eye area, in. | 9.0 | 10.5 | 10.6 | 9.3 | 10.2 |
| Fat color[c] | 2.8 | 4.6 | 4.2 | 4.0 | 4.2 |

*Significant ($P<.05$).

[a]10 = good, 7 = standard.

[b]4 = slight, 3 = traces.

[c]4 = slightly yellow tinge, 3 = slightly yellow, 4 = moderately yellow.

[d]Includes time from when steers were removed from irrigated pasture until they were slaughtered. Forage is not included in intake for the 60 days on crested wheatgrass.

[e]Includes time in feedlot after steers started on treatment.

[f]IP-SB-CW, CSM, DPW, IP-CSM, IP-DPW are irrigated pasture to feedlot at Squaw Butte to crested wheatgrass pasture, cottonseed meal, dried poultry waste, irrigated pasture to cottonseed meal ration in feedlot and irrigated pasture to dried poultry waste ration in feedlot treatment management schemes respectively.

## Conclusions

The steers in two trials gained faster on crested wheatgrass range than their counterparts on irrigated pasture during the growing period each year. The range steers continued to gain at a good rate going into the finishing period and through to slaughter. Considerable grain was saved by finishing on range as compared to the other treatments at the expense of reduced carcass quality and lowered taste preference.

Ranchers with good quality rangeland have the basic inputs to grow and finish cattle utilizing less grain than do commercial feeders. In short grain supply years, due to either human competition or low production, the range may be our best producer of beef.

Rangelands, such as those west of the Missouri River, can provide the quantities and quality of forage to produce a consistent supply of red meat using less grain.

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# UTILIZATION OF DROUGHT-STRICKEN CORN SILAGE BY YEARLING STEERS

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Corn silage is a very versatile and palatable feed that fits well into many cattle feeding programs. Insufficient rainfall in several areas of the country in recent years has resulted in many additional acres of corn being ensiled due to the low potential grain yield. Harvesting drought-stricken corn as silage results in at least partial salvage of the crop. However, many farmers have expressed concern about the feeding value of drought-damaged corn silage and how it can be best incorporated into feedlot rations for optimal performance and maximal economic return.

Corn silage typically contains a considerable amount of grain. However, the amount of grain in silage may vary from essentially none from a severely drought-stricken crop to as much as 50% of the silage dry matter from a high-yielding corn crop. In view of the large difference in energy values of corn fodder and corn grain, the energy values of silage-based rations would be expected to be influenced to a considerable degree by the proportion of grain in the corn silage. However, when the corn plant fails to produce ears, or when grain yield is markedly reduced, there is some concentration of available nutrients in the stalk and leaves. Even though much research has been conducted with corn silage fed to growing and finishing cattle, questions still remain as to the most appropriate amount of additional corn grain to feed with silage, especially when the silage contains minimal amounts of grain.

The objective of this study was to examine the feedlot performance of cattle fed whole-plant drought-stricken corn silage with varying levels of added corn grain.

## Procedures

Sixty-four yearling Hereford-Angus steers averaging about 550 lb. were purchased at a local sale barn for the experiment initiated on February 17, 1977 at the Southeast Experiment Farm near Beresford. The cattle were allotted into 8 pens of 8 head each on the basis of shrunk weight obtained after an 18-hour stand without feed and water.

Four treatments representing different levels of added cracked corn were studied, with 2 pens assigned to each treatment. The 4 experimental rations were as follows:

| Treatment | Dry Matter Basis | | As Fed Basis | |
|---|---|---|---|---|
| | Corn Silage | Corn Grain | Corn Silage | Corn Grain |
| #1 | 100% | --- | 100% | --- |
| #2 | 75% | 25% | 88% | 12% |
| #3 | 50% | 50% | 72% | 28% |
| #4 | 25% | 75% | 46% | 54% |

The corn silage was from drought-stricken corn with an estimated grain yield of 4-5 bushels/acre and a silage yield of 3-3.5 tons/acre. Average dry matter content of the silage was about 34% with an average protein content of 10.9%, dry basis. The corn grain was purchased locally as needed and averaged 13% moisture.

A custom mixed 32% crude protein supplement was fed at the rate of 2 lb. per head daily throughout the trial. The composition of the supplement was 18% ground corn, 68% soybean meal (44% protein), 7% dicalcium phosphate, 2% limestone, 5% trace mineral salt and a vitamin A (10,000 IU/lb. suppl.) and Rumensin premix. The level of Rumensin in the supplement was adjusted periodically in order to maintain the equivalent of about 30 g. of Rumensin per ton of air-dry feed in all rations.

The cattle were vaccinated for blackleg, malignant edema and red nose (IBR) and implanted with Synovex-S at the beginning of the experiment.

The cattle on the 100% corn silage ration were full-fed silage from the beginning of the experiment, whereas the steers on the other treatments were gradually brought up to a full feed of grain and corn silage. The increase to full feed on the high-grain (75% cracked corn, dry basis) ration was accomplished over a 10-day period. The cattle were fed in open, sloped concrete lots without access to shelter. The cattle were weighed at monthly intervals throughout the trial, with daily feed records kept on each pen.

The experiment was terminated for each treatment group when their average full body weights approached 1150 lb. The cattle were marketed on a grade and yield basis so that detailed carcass measurements were obtained.

## Results

The results of the trial are presented in Table 1. Average final shrunk body weights were 1082, 1113, 1140 and 1106 lb. for the cattle fed 100, 75, 50 and 25%, respectively, of their ration dry matter as drought-stricken corn silage. Percent shrink resulting from an 18-hour stand without feed and water tended to be greater on the high-silage rations.

As expected, cattle on the all-silage ration required the longest time on feed (286 days), while the high-grain fed steers took the least time (208 days). The overall daily gains (based on shrunk initial and final body weights) of the 4 experimental treatments were 1.94, 2.24, 2.57, and 2.76 lb. for the 100, 75, 50 and 25% corn silage rations, respectively. The daily gains achieved by the high-silage fed steers tended to fall off more sharply than that of their high-grain fed counterparts as the cattle approached finished weights. This observation appeared to be related in part to the erratic late fall climatic conditions to which only the high-silage fed steers were exposed. The cattle were somewhat overfinished at slaughter, as can be observed from the tabulated carcass data. The nutritional impact of carrying cattle too long is a substantially increased maintenance energy requirement along with excessive fat deposition, thereby resulting in depressed terminal performance. For example, the average daily gains (based on filled feedlot weights) achieved on the experimental rations up to mean body weights of 1025-1050 lb. were 2.30, 2.46, 2.78 and 2.99 lb. for the 100, 75, 50 and 25% corn silage rations, respectively.

The average daily feed consumption results are also shown in Table 1. Based on these data, the average dry matter intakes of the 4 sets of steers were 19.54, 20.96, 22.12 and 20.93 lb. for the 100% through 25% corn silage rations, respectively. The amount of feed required per 100 lb. gain is also presented in the table. Using data of this type, one can calculate the feed costs per 100 lb. gain based on any given set of feed prices. For example, if we value drought-stricken corn silage at $15/ton, #2 corn at $2.00/bushel and the 32% protein supplement at $150/ton, including handling and processing, then the feed costs per 100 lb. gain of these cattle would have been $28.51, $30.03, $31.21 and $30.62 for the 100, 75, 50 and 25% corn silage rations, respectively.

The carcass results are shown at the bottom of the table. Dressing percent (warm carcass weight/final filled weight x 100) decreased with increasing levels of corn silage in the ration a result primarily attributable to the greater gut fill associated with increasing amounts of roughage in the ration. Level of corn silage feeding appeared to have little influence on carcass fat thickness, rib-eye area, quality or yield grade independent of carcass weight differences. The cattle on all rations graded an average of low choice or higher. Carcass maturity, firmness, rib-eye color, % kidney fat and the incidence of liver abscesses were not significantly related to the level of corn silage feeding.

Table 1. Utilization of Drought-Stricken Corn as Silage

| | Percent Corn Silage in the Ration Dry Matter[a] | | | |
|---|---|---|---|---|
| | 100% | 75% | 50% | 25% |
| No. Animals | 16 | 16 | 16 | 16 |
| Days on Feed | 286 | 260 | 238 | 208 |
| Initial Shrunk wt., lb. | 527 | 529 | 529 | 530 |
| Final Shrunk wt., lb. | 1082 | 1113 | 1140 | 1106 |
| Avg. Daily Gain, lb. | 1.94 | 2.24 | 2.57 | 2.76 |
| Avg. Daily Ration, lb. | | | | |
| Corn Silage | 53.7 | 42.7 | 30.4 | 14.4 |
| Corn Grain | -- | 5.8 | 11.8 | 16.5 |
| Supplement | 2.0 | 2.0 | 2.0 | 2.0 |
| Feed/100 lb. Gain, lb.: | | | | |
| Corn Silage | 2771 | 1900 | 1186 | 524 |
| Corn Grain | -- | 257 | 461 | 596 |
| Supplement | 103 | 88 | 78 | 72 |
| Carcass Wt., lb. | 645 | 689 | 718 | 719 |
| Dressing Percent | 58.1 | 59.7 | 61.6 | 63.0 |
| Fat Thickness, in.[b] | 0.67 | 0.82 | 0.82 | 0.85 |
| Rib Eye Area, sq. in. | 11.20 | 11.35 | 11.88 | 12.25 |
| Yield Grade | 3.63 | 4.21 | 4.18 | 4.12 |
| Quality Grade[c] | 19.2 | 20.2 | 20.8 | 19.7 |

[a]Balance of ration composed of cracked corn, plus 2 lb/head/day of supplement.

[b]Measured over rib eye between 12 and 13th rib.

[c]19=Low Choice; 20=Avg. Choice.

## Summary and Conclusions

Sixty-four yearling black-baldy steers (16 per treatment) were fed four rations consisting of 100, 75, 50 and 25% corn silage (dry matter basis) with the balance of the ration being made up of cracked corn, in order to examine the feedlot performance of cattle fed drought-damaged corn silage supplemented with various levels of added grain. All cattle received 2 lb. of a 32% protein meal per head daily in order to provide supplemental protein, minerals, vitamin A and Rumensin.

Results of this experiment illustrate that good performance can be obtained by feeding drought-stressed corn silage to growing and finishing cattle. Average daily gain ranged from 1.94 lb. on the all corn silage ration to 2.76 lb. on the highest grain ration. Based upon this experiment and other studies conducted at this station and elsewhere, the feeding value of drought-stricken corn silage will usually be within 75-95% of normal corn silage, depending upon the length, timing and severity of drought damage. This indicates that while drought-stressed corn silage is low in grain content, a higher than normal amount of available energy must be present in the stalks and leaves in order to support the level of performance observed. Thus, the major impact of drought conditions on the ensiled corn crop is that of reduced tonnage per acre and increased harvesting costs per ton rather than on a markedly decreased feeding value.

Carcass measurements revealed little influence of level of added grain in the ration on carcass characteristics when differences in carcass weight were taken into account.

This experiment indicates that drought-damaged corn silage will likely be higher in crude protein than normal. The crude protein content of the corn silage averaged 10.9% (dry basis) in this trial, as compared with 8.0-8.5% commonly found in normal corn silage. Because of this, farmers are advised to have their corn silage analyzed for protein so that rations can be properly formulated with only the minimum protein supplementation necessary.

This study demonstrates that drought-stricken corn silage can be effectively utilized in feedlot rations as a means of salvaging a poor corn grain crop while at the same time permitting more complete utilization of the forage and grain from an acre of corn.

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# DUST-IMPREGNATED EAR TAGS FOR HORN FLY CONTROL OF PASURE CATTLE

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## Introduction

Fly control is a problem to all cattlemen during the summer months. The irritation of flies has been shown to cause decreased weight gains and loss in milk production. Cattlemen are continually looking for economical and effective means of controlling flies under various management systems. Among the more recently developed fly control possibilities has been an insecticide dust-impregnated ear tag. The idea was developed for control of ear ticks in Texas. The tags are white, about 2 by 2 1/2 inches in size and about the same weight as a standard, plastic tag commonly used for identifying cattle. They are applied with a standard Allflex pliers. Rabon (2-chloro-1-(2,4,5-trichlorophenyl)) vinyl dimethyl phosphate (13.7% w/w) is impregnated in the plastic ear tag in such a way that the tag continually "dusts" the animal as it moves its head. Marking paint on the tags lasted up to 5 months in these studies.

## Experiment With Yearling Heifers Fed Grain on Pasture

The heifers were treated on June 8, 1978, and turned into alfalfa-brome-intermediate wheatgrass pastures near Brookings. The pretreatment fly count was less than 10 flies per head. The ear-tagged heifers (treated) were balanced as to pasture treatment with an equal number of untreated controls. Fly counts were recorded at intervals up to 86 days and the weight gains on pastures are shown for 133 days. Table 1 shows the results of horn fly counts in number of flies per side and table 2 shows the weight gain comparisons.

Table 1. Horn Fly Counts
(40 yearling heifers per group)

| Date of count | Days post-treatment | Rabon ear tag | Control (no treatment) | Apparent control (%) |
|---|---|---|---|---|
| 6-20-78 | 12 | <10 | 75 | >86 |
| 6-29-78 | 21 | <10 | 75 | >86 |
| 7-25-78 | 47 | <10 | 200 | >95 |
| 8- 1-78 | 53 | <10 | 150 | >93 |
| 8-17-78 | 70 | <10 | 170 | >94 |
| 9- 2-78 | 86 | <10 | 210 | >95 |

Table 2. Summer Weight Gains

| | Rabon ear tag | Control (no treatment) |
|---|---|---|
| No. animals | 40 | 40 |
| Filled wt. June 7, lb. | 581 | 586 |
| Filled wt. Aug. 2, lb. | 673 | 667 |
| Avg daily gain, lb. (6/7 to 8/2, 56 days) | 1.61 | 1.44 |
| Filled wt. Sept. 5, lb. | 723 | 716 |
| Avg daily gain, lb. (8/2 to 9/5, 34 days) | 1.52 | 1.45 |
| Avg daily gain to date, lb. (6/7 to 9/5, 90 days) | 1.58 | 1.45 |
| Shrunk wt. Oct. 19, lb. | 755 | 760 |
| Avg daily gain last period, lb. (9/5 to 10/19, 44 days) | .73 | 1.00 |
| Avg daily gain to date, lb. (6/7 to 10/19, 133 days) | 1.48 | 1.50 |

Results

Rabon insecticide-impregnated ear tags showed an apparent 86 to 95% reduction in horn flies over the untreated controls for 86 days beginning on June 7, 1978. Fly counts after September 2 are not reported as they were extremely variable due to cool weather. Accurate fly counts are difficult to obtain. Binoculars were used at close range. Wind and temperature greatly affect counts. Note the high numbers for the controls on July 25 and then another build-up about September 2. These highs are generally preceded by a few weeks of hot and humid weather.

Pasture weight gains for the treated heifers showed a gain of .17 lb. daily over the untreated controls for the first 56 days or 10 lb. per head. The treated heifers held a 12 lb. advantage for the first 90 days. The untreated heifers gained .27 lb. per day more during the last 44 days of the pasture season, resulting in similar gains during the 133-day experiment for treated and control heifers. This compensatory gain occurred from September 5 to October 19 or after the heavy fly numbers that irritate cattle. The Rabon-impregnanted ear tag had no apparent effect on control of face flies. Some sore ears were observed but not considered a problem. Marking ink numbers put on the tags were readable after 5 months. No tags were lost during the study.

Summary

Impressive horn fly control was obtained from Rabon dust-impregnated ear tags, reducing fly numbers from 86 to 95% in comparison to untreated controls over an 86-day period starting June 7, 1978. The treated heifers had outgained their untreated controls by 12 lb. per animal or .13 lb. per day at 90 days following the June 7 treatment. The untreated heifers caught up in weight gain, however, during the last 44 days or after the major fly annoyance had passed.

## Experiment With Yearling Heifers Under Range Conditions

On June 2, 1978, 56 head of Hereford heifers on the Mark Keffeler ranch located about 20 miles east of Sturgis in western South Dakota were ear tagged. The tags were put in the ears with the standard plier tool. Excess hair was trimmed out of the ear and the tool was dipped in alcohol between each use. Fly counts on the day of treatment averaged 80 flies per animal. The heifers were pastured in adjacent pastures, but the pastures were large. The untreated animals (52 head) were grazed in a 640-acre pasture. The single ear tagged group (27 head) were in a 320-acre pasture and the double ear tagged heifers (28 head) in a pasture of similar size. Subsequent fly counts were made at close range from a pickup truck using binoculars. An attempt was made to count the same 10 animals in each treatment group at each count, and the counts are reported as flies per side. Table 1 shows count dates and fly number comparisons.

Table 1. Horn Fly Counts--Keffeler Ranch

| Count date | Days post-treatment | Single tag | Double tag | Control (no treatment) | Apparent control (%) |
|---|---|---|---|---|---|
| 6-18-78 | 16 | <10 | <10 | 42 | >75 |
| 7- 5-78 | 33 | < 5 | < 5 | 47 | >89 |
| 7-31-78 | 59 | <12 | <12 | 200 | >94 |
| 8- 6-78 | 65 | 12[a] | 12[a] | 154 | >92 |
| 8-21-78 | 80 | 9[a] | 9[a] | 102 | >91 |
| 9- 9-78 | 99 | 75[a] | 75[a] | 300 | 75[b] |

[a] Single and double ear tagged groups mixed together.
[b] Considered inadequate for fly control treatment.

Summary

The ear tag treatment successfully reduced horn fly numbers in this study to a satisfactory degree for about 90 days. Horn fly count reductions varied from 75 to 94% when compared with untreated animal counts from June 2 through September 9. For the first 59 days of this study before the two treated groups were mixed, there were no noticeable fly number differences between one or two tags per animal. Some infected ears were observed due to the tags but no more than from conventional marking tags according to the herd's owner. The few face flies observed on this ranch showed no differences between treated and control animals.

## Experiment With Stock Cows Under Range Conditions

Sixty-three Angus cows were double-tag treated on the Greg Weber ranch in west-central South Dakota on July 1, 1978. A neighboring herd of heifers located about 1 1/2 miles from the treated herd was used as the untreated control. Pretreatment horn fly counts were 250 flies per side on the test cows. An attempt was made to count the same 10 animals in each herd each time. The horn fly counts reported are flies per side of each animal. Fly counts were made at close range from a pickup truck using binoculars.

Table 1. Horn Fly Counts Per Side

| Count date | Days post-treatment | Ear tag treated | Controls (untreated) | Apparent control (%) |
|---|---|---|---|---|
| 7- 5-78 | 4 | 10 | 116 | 91 |
| 8- 7-78 | 33 | 3.5 | 115 | 97 |
| 8-20-78 | 46 | 6.5 | 60 | 89 |
| 9- 8-78 | 65 | <15 | >200 | >92 |

## Summary and Results

Horn fly control was very good over the 65-day observation period. Control varied from 89 to 97% when compared to the untreated animals. The rancher liked the method of treatment for horn flies and was satisfied with it. Of the 62 animals treated only two tags were lost and 12 tags resulted in slight infections. Marking ink numbers on the tags were easily readable but somewhat faded. These observations were made on October 25, about 4 months after treatment.

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# WEED CROPS FOR SILAGE

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At times seedings of small grains, grasses and legumes become heavily infested with weeds because of inadequate cultural practices or weather conditions favoring growth of various weeds more than the seeded crop. Under such conditions, the weed crop may offer some potential feed for cattle and sheep if cut at the proper stage from the standpoint of weed control and the most potential as a possible feed source. Numerous questions have been asked in past years as to the feeding value of crops where weeds make up a major portion of the total forage. Questions are also raised as to harvesting and storage methods and how such potential feedstuffs might be used to the greatest advantage in rations for cattle and sheep.

Limited reported data are available because management practices are aimed at minimizing weed problems and quantities for experimental use are not frequently available. Also, species composition is variable making it difficult to have a feedstuff uniform enough in composition to describe and evaluate. Even with these limitations, feeding experiments with forage containing large amounts of various weeds can serve as a basis for recommended use.

## Procedures

Both cattle and sheep were used in the experiment to evaluate a weed crop for low-moisture silage (haylage). Oat haylage harvested near the same time was used for comparative purposes.

### Description of Forages

A 25-acre field was seeded to oats at 1 bushel per acre as a nurse crop for alfalfa in the spring of 1977. There appeared to be a good stand of oats and growth was progressing at a normal rate in the spring. About the middle of June, approximately 7 inches of rainfall was received in 1 week. Shortly thereafter, a thick crop of weeds began to grow rapidly. Lambsquarters, kochia, pigeon grass and Russian thistle made up the major portions of the weeds.

At time of windrowing on July 11, there was a thick stand of weeds with many being 4 to 5 feet in height. Estimated percentages of weight from visual appraisal were 40% lambsquarters, 30% kochia, 5% Russian thistle, 5% pigeon grass and 20% oats. There was considerable variation in various areas of the field. Seeds were beginning to form for lambsquarters and kochia, hard dough stage for pigeon grass and hard dough to mature for oats.

The forage was chopped on July 14. A long drying time was considered needed because of the heavy growth. Favorable drying weather and the fluffy nature of the windrows resulted in faster drying than expected. Dry matter of samples taken from the chopped forage averaged 72.82%.

The heavy windrows of coarse weeds presented problems in chopping. Windrows were divided with a side-delivery rake to facilitate chopping.

Because of the dry nature of the forage, water was added as the forage was blown into a concrete stave silo using a 4/8-inch garden hose and full pressure from a 1-inch hydrant. Yield of dry forage as harvested from the 25 acres was approximately 100 tons.

Forage used for comparison of the feeding value of the weed crop was oats harvested as haylage and stored in a Harvestore silo. This forage was stored at 52.36% dry matter. The oat forage yield was about 2 ton of dry matter per acre with a grain yield estimated at 25 bushels per acre. There was considerable variation in grain maturity because of dry soil conditions in the spring, resulting in considerable variation in emergence of plants, and from hail damage.

Animals and Rations

Twenty-four steers were allotted into four pens of six each for the study with cattle. The weed haylage was fed to the cattle in two pens and the oat haylage to those in the other two pens. Each forage was fed to appetite with free access to a calcium-phosphorus supplement and trace mineral salt. The cattle experiment was terminated after 77 days.

Eighty lambs (32 wethers, 32 ewes and 16 rams) were allotted into ten pens of eight each (4 ewes and 4 wethers or 8 rams per pen) on basis of weight. The weed haylage was fed to lambs in five pens and oat haylage to those in the other five pens.

In the lamb experiment, the forage portion was limited rather than feeding as the only feed with minerals as in the cattle experiment. Rolled corn grain was fed at 2 lb. per head daily with each kind of forage then being offered to appetite. This provided a comparison of forage consumption when grain formed a large portion of the ration. A calcium-phosphorus supplement and trace mineral salt were provided on a free-choice basis.

The lamb experiment was terminated after 72 days.

## Results

Samples of each forage were taken at approximately weekly intervals during the experiments. Average dry matter was 65.88 (water added during filling the silo) and 49.50%, respectively, for the weed and oat haylages.

Cattle Experiment

Results of the cattle experiment are shown in table 1. Rate of gain was .69 lb. daily for cattle fed weeds in comparison to 1.38 lb. for those fed oat haylage. Feed intake was higher for the oat haylage, but it had less dry matter. On a dry basis, daily feed intake was 1 lb. more for steers fed the weed haylage. Therefore, differences in performance would be from less efficient utilization of the weeds since palatability did not appear to be a problem.

On basis of feed efficiency, the weeds had only 47% (dry basis) the value of the oat haylage.

### Lamb Experiment

Results of the lamb experiment are shown in table 2. Rolled corn grain was fed at 2 lb. per head daily after increasing to this level during the first few days of the experiment. Each forage was fed to appetite.

Lamb gains were essentially the same for the weed and oat haylages under the conditions of feeding. Dry matter intake was slightly higher for the weeds, indicating no problem of palatability when fed with the corn.

Corn per unit of gain was about the same for the two groups of lambs since weight gains were similar and each group was fed the same level of grain. Forage requirements (dry basis) were slightly higher for the weeds than for oat haylage. In this case the weeds had 80% (dry basis) the value of the oat haylage.

## Summary and Comments

Steers fed haylage forage made from a crop of weeds (predominantly lambsquarters and kochia) gained considerably less than steers fed oat haylage. The oat haylage had a low amount of light weight grain (about 20% of forage dry matter and a test weight of 26 lb. per bushel). The gain when feeding oat haylage was low in comparison to that obtained in other trials with high quality oat forage. Feed intake (dry basis) indicated that palatability was not a problem. On basis of feed efficiency (dry basis), the weed haylage had a value of only 47% that of the oat haylage when either comprised the total ration with supplemental minerals.

When fed to fattening lambs with corn grain (about 60% of the ration), daily gain was about the same for the weed and oat haylages. Lambs fed the weed haylage consumed more forage dry matter. Feed requirement as corn was about equal for the two groups. Forage dry matter requirements were higher for the weed haylage. In this comparison, the weed haylage had a value about 80% that of the oat haylage.

While no comparisons were made of weeds as dry or wet forage in the experiment, the nature of such plants would indicate the silage route for best feed consumption and minimum waste. Considerable variation would be expected in feeding value depending upon kind and amount of weeds and stage of maturity when harvested.

Such off-quality feedstuffs generally have more value when forming a part rather than the major portion of rations. This is indicated in these experiments. Possible differences between sheep and cattle cannot be ignored. Sheep may make better use of such feedstuffs than cattle. However, sheep have appeared to be a good experimental animal in evaluating forage crops for ruminants.

Table 1. Weed Haylage *vs* Oat Haylage for Growing Cattle (September 9 to November 23, 1977--77 days)

| Item | Weed haylage | Oat haylage |
|---|---|---|
| Number steers | 12 | 12 |
| Avg init. shrunk wt., lb. | 673 | 676 |
| Avg final shrunk wt., lb. | 726 | 782 |
| Avg daily gain, lb. | .69 | 1.38 |
| Avg daily forage intake, lb. | | |
| As fed | 25.1 | 31.4 |
| Dry basis | 16.5 | 15.5 |
| Feed/100 lb. gain, lb. | | |
| As fed | 3638 | 2275 |
| Dry basis | 2397 | 1126 |

Table 2. Weed Haylage *vs* Oat Haylage for Finishing Lambs (September 8 to November 19, 1977--72 days)

| Item | Weed haylage | Oat haylage |
|---|---|---|
| Number lambs | 39[a] | 40 |
| Avg init. wt., lb. | 86.6 | 87.0 |
| Avg final wt., lb. | 116.8 | 117.4 |
| Avg daily gain, lb. | .421 | .422 |
| Avg daily feed, lb. | | |
| As fed | | |
| Corn grain | 1.94 | 1.94 |
| Forage | 1.79 | 1.92 |
| Dry basis | | |
| Corn grain | 1.68 | 1.68 |
| Forage | 1.18 | .95 |
| Feed/lb. gain, lb. | | |
| As fed | | |
| Corn | 461 | 460 |
| Forage | 425 | 455 |
| Dry basis | | |
| Corn | 399 | 398 |
| Forage | 280 | 225 |

[a] One death loss during first month of experiments. Results are for the 39 head.

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